MiG-23
Airworthiness Certification

AIR-230 Airworthiness Certification Branch
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Cover Photograph: Dr. Stefan Petersen, Lt. Col. German Air Force, Ret.
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Introduction – MiG-23 Airworthiness Certification

This document provides information to assist in the airworthiness certification and safe civil operation of a MiG-23 aircraft.

Attachment 1 provides a general overview of this document. Attachment 2 contains background information on the MiG-23 aircraft. Attachment 3 lists historic airworthiness issues with the MiG-23 for consideration in the certification, operation, and maintenance of these aircraft. The list is not exhaustive, but includes our current understanding of risks that should be assessed during in the certification, operation, and maintenance of these aircraft. Concerns regarding particular issues may be mitigated in various ways. Some may be mitigated via the aircraft maintenance manual(s) or the aircraft inspection program. Others may be mitigated via operating procedures i.e., SOPs) and limitations, aircraft flight manual changes, or logbook entries

Not all issues in attachment 3 may apply to a particular aircraft given variations in aircraft configuration, condition, operating environment, or other factors. Similarly, circumstances with an aircraft may raise other issues not addressed by attachment 2 that require mitigation. Attachment 4 includes additional resources and references. Attachment 5 provides some relevant MiG-23 accident and incident data.

Attachment 1 – Overview of this Document

Purpose

This document is to provide all those involved in the certification, operation, and maintenance of the MiG-23 aircraft with safety information and guidance to help assess and mitigate safety hazards for the aircraft. The existing certification procedures in FAA Order 8130.2, Airworthiness Certification of Aircraft and Related Products, do not account for many of the known safety concerns and risk factors associated with many high-performance former military aircraft. These safety concerns and risk factors associated with many high performance former military aircraft include—

- Lack of consideration of inherent and known design failures;
- Several single-point failures;
- Lack of consideration for operational experience, including accident data and trends;
- Operations outside the scope of the civil airworthiness certificate;
- Insufficient flight test requirements;
- Unsafe and untested modifications;
- Operations over populated areas (the safety of the non-participating public has not been properly addressed in many cases);
- Operations from unsuitable airports (i.e., short runways, Part 139 (commercial) airports);
- High-risk passenger carrying activities taking place;
- Ejection seat safety and operations not adequately addressed;
- Weak maintenance practices to address low reliability of aircraft systems and engines;
- Insufficient inspection schedules and procedures;
- Limited pilot qualifications, proficiency, and currency;
- Weapon-capable aircraft not being properly demilitarized, resulting in unsafe conditions;
- Accidents and serious incidents not being reported; and
- Inadequate accident investigation data.

Research of MiG-23 Safety Data

The aircraft, relevant processes, and safety data are thoroughly researched and assessed. This includes—

- Aviation Safety (AVS) Safety Management System (SMS) policy and guidance;
- Historical military accident/incident data and operational history;
- Civil accident data;
- Safety risk factors;
- Interested parties and stakeholders (participating public, non-participating public, associations, service providers, air show performers, flying museums, government service providers, airport owners and operators, many FAA lines of business, and other U.S. Government entities);

- Manufacturing and maintenance implications; and
- Design features of the aircraft.

This Document

The document is a compilation of known safety issues and risk factors identified from the above research that are relevant to civil operations. This document is organized into four major sections:

- General airworthiness issues (grey section),
- Maintenance (yellow section),
- Operations (green section), and
- Risk management, standard operating procedures and best practices (blue section).

This document also provides background information on the aircraft and an extensive listing of resources and references.

How to Use the Document

This document was originally drafted as job aids intended to assist FAA field office personnel and operators in the airworthiness certification of these aircraft. As such, some of the phrasing implies guidance to FAA certification personnel. The job aids were intended to be used during the airworthiness certification process to help identify any issues that may hinder the safe certification, maintenance, or operation of the aircraft. The person performing the certification and the applicant would to discuss the items in the job aid, inspect documents/records/aircraft, and mitigate any issues. This information would be used to draft appropriate operating limitations, update the aircraft inspection program, and assist in the formulation of adequate operating procedures. There are also references to requesting information from, or providing information to the person applying for an airworthiness certificate. We are releasing this document as drafted, with no further updates and revisions, for the sole purpose of communicating safety information to those involved in the certification, operation, and maintenance of these aircraft. The identified safety issues and recommended mitigation strategies are clear and can be considered as part of the certification, operation, and maintenance of the air aircraft.

Attachment 2—Background Information on the MiG-23

For over 30 years, the MiG-23/27 Flogger (NATO Codename) series of aircraft was used extensively by the former Soviet Union and its Warsaw Pact allies. The MiG-23 series served as fighter-interceptors, with a secondary capability of ground attack. In the early 1980s, the MiG-23 was the backbone of VVS (Soviet Air Force) Frontal Aviation air defense/air superiority assets. No fewer than 1,100 MiG-23s were allocated to Soviet frontline units. The aircraft also served extensively as a ground attack asset.

Some of the former Soviet Block countries, including Bulgaria, the Czech Republic, Poland, and Romania used the aircraft well into the late 1990s and early 2000s. The MiG-23 has had and continues to have an extensive military career. It was engaged in numerous conflicts, including Angola, the Iran-Iraq War, the Soviet intervention in Afghanistan, the 1982 Lebanon War, the Sri Lankan civil war, the Indo-Pakistan conflicts, and recently in both the Libyan and Syrian conflicts. The MiG-23 was one of the Soviet aircraft types that participated in the attempted interceptions of KAL 007 airliner on September 1, 1983, which was eventually shot down by another Soviet fighter.

Taken during an actual interception, this view is of a heavily armed Soviet Air Force MiG-23 in flight during the 1980s in a slow flight configuration. Source: USAF.

The MiG-23 was designed between 1964 and 1966 as a successor to the MiG-21. In addition to a much more powerful engine, the MiG-23's most significant new feature was its variable sweep wing. The MiG-23MLD Flogger K version was a modification of the MiG-23ML Flogger G, and incorporated improved avionics, armament, and aerodynamic features. Aircraft 23-11 (initial designation), prototype of the MiG-23, made its maiden flight on June 10, 1967, with the wings remaining in minimum sweep position (that is, fully extended). During flight testing of the MiG-23 in 1969, test pilots noted the aircraft displayed dangerous behavior when high angles of attack were combined with a certain sideslip, and the aircraft was judged to be prone to spinning in certain circumstances.

These qualities were considered hazardous to flight safety by the time the aircraft entered service in number. Also, the center fuselage welding joints and the wings often developed cracks, requiring urgent structural strengthening. Two MiG-23s were lost within a week in September 1970. One exceeded maximum speed, killing the pilot, and the other was lost during low-altitude operations while maneuvering at a high angle of attack, but supposedly within stall limits. There was a 4 G limit put on the first-production MiG-23s, specifically for the airframes.

In 1972, the first generation of the MiG-23 Flogger commenced operation. It is estimated that between 1969 and 1984, 6,630 fighters rolled off the production line with various derivatives, exported to at least 26 countries. Today, the MiG-23 is no longer in service with the Russian Air Force. The Ukrainian Air Force operated the last MiG-23MLD until 2001, and those in Bulgaria were active until November 2002. Russia began scrapping many of its MiG-23s in 1993 following the collapse of the Soviet Union. However, the swing-wing fighter is still being used by countries including Syria, North Korea, Libya, India, Angola, and Cuba. The Ivory Coast recently acquired two ex-Bulgarian MiG-23MLDs (Export) in the spring of 2003.

Twilight photo of an East German Air Force MiG-23ML photographed in 1990. Source: Dr. Stefan Petersen. Copyright © 1990. www.airliners.net.

The engine for the MiG-23 aircraft was deliberately a turbojet, and not a turbofan, to gain the best possible takeoff performance, acceleration, and climb figures. The Tumansky R-27 engine laid the foundation for the MiG-23 aircraft, rated 5,200 kg (or 7,800 kg with afterburner), and gave the 23-11 a fuel consumption 25 percent lower than that of the MiG-21 aircraft. The greater pressure rise generated at each stage was achieved by advanced aerodynamics and metallurgy. The new engine was not perfect, however, at least in the early stages. Later model MiG-23s used the Tumansky OKB R-29-300.

The MiG-23 is a complex combat aircraft designed for frontline service. As such, it incorporates many compromises into its design, maintenance, and operation. Many of these are not suitable for civil operations unless adequately mitigated. The aircraft operational history illustrates these deficiencies, namely in terms of mechanical failures. Many were engine failures and fires. Loss of control is another critical issue. It is not an easy aircraft to master. From a risk standpoint, it is noted that the aircraft that have been certificated operate rarely, and as such, there is a very limited level of expertise in safely operating and maintaining the aircraft.

At one stage, the accident rate was so high that the aircraft was picking up a reputation similar to that gained by NATO F-104s. However, while the exact causes of the F-104 were released and action taken, the same cannot be said for the MiG-23. Little is known of the safety record of the aircraft in Soviet service, although there are indications that it was not very good. This compiles the issue because the data that is available is, in many cases, insufficient to allow proper mitigation, especially in civil use. This in turn, requires a very conservative approach, as discussed in this document.

In full afterburner, two Romanian Air Force MiG-23ML at rotation during a formation take-off in 2001 shortly before the type was retired. The aircraft continued to serve with that air force for over 10 years after the collapse of the Soviet Union and the dissolution of the Warsaw Pac in March of 1991. Source: Chris Lofting. Copyright © 2001. www.airliners.net.

As an example of the aircraft's operational history, it is noted that between its introduction in 1981 and its phase-out in 2007, the IAF operated four MiG-23BNs squadrons consisting of over 70 aircraft (three squadrons of the MiG-23BN ground attack fighters and one squadron of the MiG-23MF air defense fighters), and half of those aircraft were lost in accidents (a 50 per cent attrition rate). In fact, by 2007, only 13 MiG-23BNs were still operational.

Based on a total of 154,000 hours of operation in Indian Air Force (IAF) service, the MiG-23BN/MF had an accident rate of 22 per 100,000 hours. This number is likely to be low because it does not include accidents were the airframe was not destroyed (IAF classification of Category I accidents, where the aircraft is totally damaged), and yet would be classified as accidents, either under the “Class A Mishap” classification used by the U.S. Air Force (USAF) and U.S. Navy or under the National Transportation Safety Board’s Part 830. A corrected estimate would place the accident rate at about 35 per 100,000 hours. In Hungarian Air Force service, the MiG-23 accident record was 28.7 per 100,000 hours based on 20,876 hours and 6 aircraft destroyed. As with the Indian Air Force, the actual rate was higher due to the fact when Class A mishaps where the aircraft was not destroyed are included.

This dubious safety record included numerous mechanical failures, many of which were engine failures and fires. At the time, the aircraft was phased out because of increasing maintenance costs and problems relating to non-availability of spare parts. Several factors contribute to the IAF’s high MiG-23 accident rate: (1) aging aircraft of the 1970s vintage with design limitations difficult to overcome, (2) direct exposure of inexperienced pilots to highly unforgiving supersonic aircraft without limited transitional training, (3) the absence of new-generation flight simulators to train pilots on how to effectively handle emergencies, and (4) poor maintenance and inadequate quality control on spares and rotables.

It has to be said, however, that over the period in which it operated the type, the Indian Air Force constantly improved its processes and especially its safety management approach to frontline fighter operations. Many of those lessons are today in place for MiG-27 operations, and the type’s operational record has improved over the years.

Above, a Soviet MiG-23 during maneuvering illustrating the aircraft’s swing-wing in action. Also note the lack of ailerons. Source: USAF.

A Czechoslovakian AF MiG-23ML single-seat interceptor taxing for a training mission in 1990. Note the complete set of external pylons mounted on this aircraft; two on the inboard wing stations, two on the outboard fuselage station, and one in the fuselage centerline station. Also visible under the nose gear and almost flush with the fuselage is the infrared tracking sensor, used as part of the aircraft's air-to-air missile weapon system. The splitter plate mounted by the air intake is clearly pronounced, a necessity in order to reduce the speed of the airflow entering the engine during supersonic flight. Source: Georg Mader. Copyright © 2013. Below, a camouflaged Hungarian Air Force MiG-23MF seen during take-off in 1991. In this particular case, note the deployed slats and folded ventral fin. Source: Chris Lofting. Copyright © 2013.

Fatal accident of a Hungarian Air Force MiG-23MF during an air display at Papa AB on September 16, 1990. The accident was the result of the pilot operating the aircraft with the wrong wing swept setting at low altitude while maneuvering. Source: Georg Mader. Copyright © 1990. www.airliners.net.

Soviet MiG-23 accident in the 1980s at Vladivostok. Source: Georg Mader. Copyright © 2013.

An USAF MiG-23 belonging to the 4477th TES on the ramp at Tonopah, Nevada in 1987. This unit operated up to 10 such aircraft. Source: USAF.

While data on the MiG-27 operational history with the MiG-27 is not complete, the IAF has lost 12 MiG-27s to crashes since 2001. In mid-February 2010, India grounded its entire fleet of over 150 of the aircraft after a MiG-27 crashed on February 16, 2010, in Siliguri, West Bengal. The crash was attributed to defects in the R-29 engines of the aircraft, suspected to have occurred during the overhauling of the aircraft by Hindustan Aeronautics Limited. The data above points to caution as the main element is both certificating and operating a MiG-23/MiG-27.

Indian Air Force MiG-27 during take-off with full afterburner and the take-off flap setting. The immense power and acceleration of the aircraft is evident as soon as it lifts of the ground. Source: Indian Air Force.

The operational experience by the IAF, both in terms of MiG-23 and MiG-27 experience cannot be underestimated, not just because of the number of aircraft in service and their length of service, but also because the IAF is relatively transparent and accidents investigated and made public. In addition, it publishes critical flight safety data as part of its operational programs. The availability of such data is not easily obtainable from former Warsaw Pact countries during the Cold War.

As with many other former Soviet aircraft, many MiG-23s were imported into the United States after the collapse of the Soviet Union. Although a late top of the line MiG-23 model was sold at just $6.6 million each in the, those acquired by US operators were discarded by former Soviet Block countries at rock-bottom prices (under $80,000, essentially scrap value) after having reached the end of their 1,500-hours life-limit or very close to it. Many went to museums, but a few were acquired with the intent of seeking airworthiness certification. In comparison, airworthy MiG-23s with hours left can be found being sold for about $1.6 million. The difference in value is representative of not only their condition, but operational life remaining.

There are 11 MiG-23s in the FAA registry and 3 have been issued airworthiness certificates. Warbirds of Delaware has two MiG-23s (N51734 and N5106E). Another, N23UB, having reached its 1,500-hour limit, was posted for sale in January 2013. No other civil MiG-23s are operating anywhere else in the world.

As a point of reference, in the late 1970s and into the 1980s, the USAF evaluated and later operated several MiG-23s as part of its evaluation and combat training programs. As a result, some data exists that can be used to determine the airworthiness of the aircraft in civil use. Much of this data is incorporated in this document and should be considered as part of certification. This is important because the USAF had serious issues with the aircraft, including engine reliability and critical handing issues. Operated by the USAF between 1981 and 1988, the MiG-23's safety record was not good. A total of three airframes were (Class A mishap may have been higher) lost in under 6,000 hours of operation. This equates to an accident rate of 50 per 100,000 hours. This rate does not include those cases where there was an accident but the airframe was not destroyed. Therefore, the actual rate was higher.

Top, an Indian Air Force MiG-23BN on final. Note the folded ventral fin. Above, an Indian Air Force interceptor version of the MiG-23, the MG-23MF on short final as well. Note the extended ferrying external fuel tank set-up in this case; with two external fuel tanks mounted don the wings and one in the fuselage centerline. The extended landing lights are also visible. Source: Indian Air Force.

To summarize the MiG-23, retired Air Force Lt. Col. Clem Myers, who flew the MiG-23 for the USAF, "pulled no punches when talking about the lack of safety margin for the Flogger. There's only one airplane I've ever been afraid of, and that's the MiG-23, Myers said. That thing was trying to kill you from when you started it to when you shut it down. I never flew an airplane that didn't give some indication it was going out of control, and this thing did not give any warning. On top of the Flogger's handling characteristics, Myers said the MiG-23 canopies had a nasty tendency of imploding under vigorous air-combat maneuvers." Another USAF pilot, John Manclark who was the commander of the 4477th Test & Evaluation Squadron from 1985-87 (8-10 MiG-23 and the same number of MiG-21s) notes that "the MiG-23 was a nightmare, maintenance was a nightmare. The guys hated flying it..." This statement is tricking not just because it raises concerns on its face, but because of the fact that the aircraft were dangerous and problematic despite of the fact that this USAF unit had 210 dedicated and experienced maintenance personnel and a large amounts of resources and funds, in addition to very experience pilots (2,000-3,000 hours total time).

MiG-23 Aircraft in the FAA Registry (January 2013)

Mfr/Mdl Code	Number of Aircraft Assigned	Manufacturer Name	Model Name	Type Aircraft	Type Engine	Aircraft Category
0561704	OKLAHOMA - 6 Total = 6	MIKOYAN GUREVICH	MIG 23	Fixed Wing Single-Engine	Turbo-jet	Land
056210Y	FLORIDA - 1 Total = 1	MIKOYAN GUREVICH	MIG-23ML	Fixed Wing Single-Engine	Turbo-jet	Land
05604BD	DELAWARE - 2 FLORIDA - 1 TEXAS - 1 Total = 4	MIKOYAN GUREVICH	MIG-23UB	Fixed Wing Single-Engine	Turbo-jet	Land

Soviet Air Formce MiG-23MLD photopgraed by the USAF in 1986 during an intercept. Source: http://www.dodmedia.osd.mil.

Two close-up views of Indian Air Force MiG-23s. Above, on approach, note the external fuel tanks, which when used, limit the swept wing to a setting of 16º. Below, the tail of a MiG-23 clearly show many of the aircraft particularities, including air brakes, folding ventral fin, JATO rockets attach points, and the drag chute cone. Source: Indian Air Force.

Above, a long line of Ukrainian Air Force MiG-23s in open storage in 2009. Below, a MiG-23UB retired from the Bulgarian Air Force awaits its fate. Bottom, two civilian-owned MiG-23s (one is a two-seat MiG-23UB) seen on the ramp at the Sarasota airport, Florida in 2007. Source: Georg Mader. Copyright © 2007.

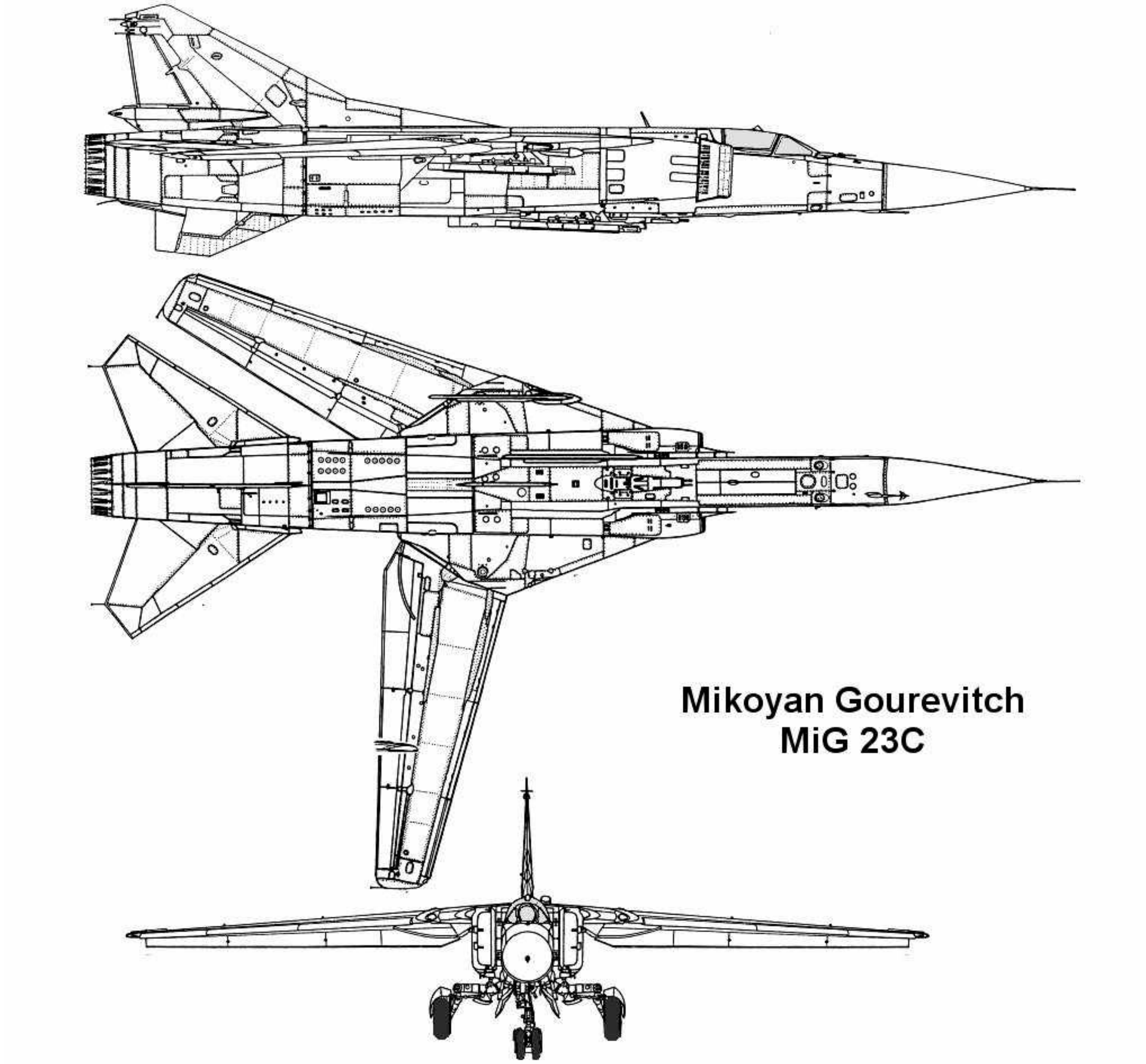
Above, a dilapidated Ex-Bulgarian Air Force MiG-23BN Flogger H photographed in 2012. Below and bottom, Ex-Bulgarian Air Force MiG-23UB and MiG-23MFs in open storage in 2007. Source: Alexander St. Alexandrov. Copyright © 2012.

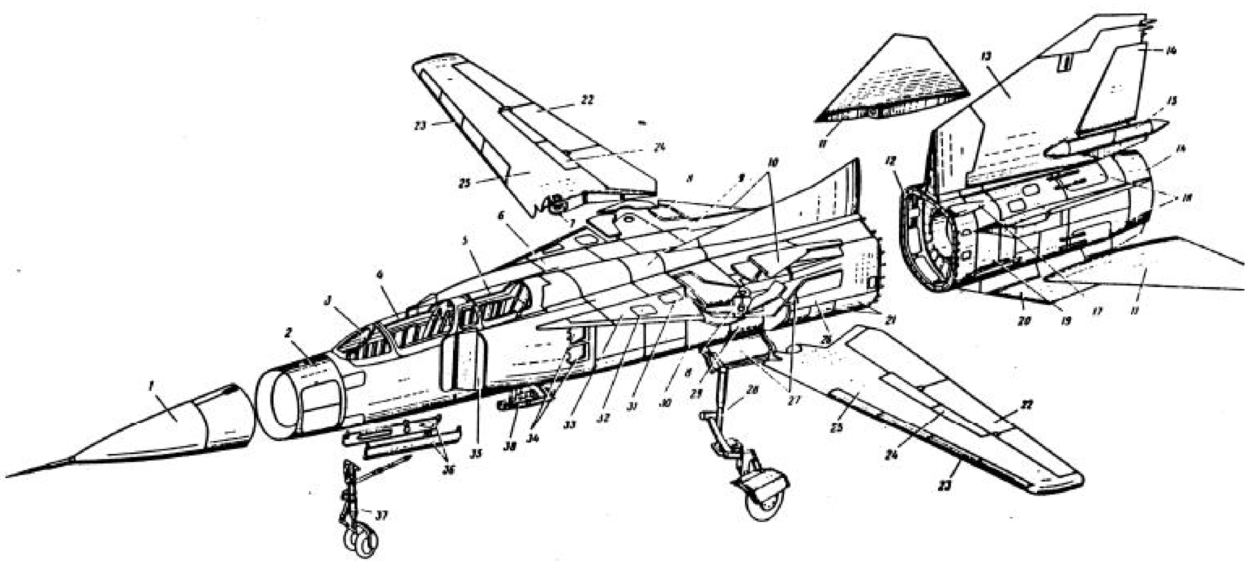
Above, an ex-Bulgarian Air Force MiG-23MLD Flogger in open storage. Source: Alexander St. Alexandrov. Copyright © 2012. Below, an Indian Air Force MiG-27ML deploys the drag chute after touchdown, which is an absolute necessity in the safe operation of the aircraft. Source: Indian Air Force.

Above, two USAF technicians working on the critical MiG-23's swing wing. Below, the USAF Museum's MiG-23. Source: USAF

Above, Czech AF MiG-23BN, a ground attack version of the aircraft. Source: Petr Pribyl. Copyright © 2007. Below, a freshly overhauled MiG-23UB for the Kazakhstan Air Force in 2011. Source: Georg Mader. Copyright © 2011.

A Hungarian Air Force MiG-23UB being prepared for flight in 1990. Note the four-man crew. Source: Georg Mader. Copyright © 1990.


Mikoyan Gourevitch
MiG 23C



Specifications (MiG-23MLD Flogger-K)

General Characteristics

- Crew: One
- Length: 16.70 m (56 ft. 9.5)
- Wingspan: Spread, 13.97 m (45 ft. 10 in)
- Height: 4.82 m (15 ft. 9.75 in)
- Wing area: 37.35 m² spread, 34.16 m² swept (402.05 ft² / 367.71 ft²)
- Empty weight: 9,595 kg (21,153 lb.)
- Loaded weight: 15,700 kg (34,612 lb.)
- Maximum Take-off weight: 18,030 kg (39,749 lb.)
- Powerplant: 1 × Khatchaturov R-35-300 afterburning turbojet, 83.6 kN dry, 127 kN afterburning (18,850 lb. / 28,700 lb.)

Performance

- Maximum speed: Mach 2.32, 2,445 km/h at altitude; Mach 1.14, 1,350 km/h at sea level (1,553 mph / 840 mph)
- Range: 1,150 km with six AAMs combat, 2,820 km ferry (570 mi / 1,750 mi)
- Service ceiling: 18,500 m (60,695 ft.)
- Rate of climb: 240 m/s (47,245 ft./min)
- Wing loading: 420 kg/m² (78.6 lb./ft²)
- Thrust/weight: 0.88

Armament

- 1 Gryazev-Shipunov GSh-23L 23 mm cannon with 200 rounds
- Two fuselage, two wing glove, and two wing pylons for up to 3,000 kg (6,610 lb.) of stores, including: R-23/24 (AA-7 “Apex”), R-60 (AA-8 “Aphid”), R-27 (AA-10 “Alamo”), R-73 (AA-11 “Archer”), R-77 (AA-12 “Adder”)

Specifications (MiG-23UB)

General Characteristics

- Crew: 2: student and instructor
- Length: 16.70 m (56 ft. 9.5)
- Wingspan: Spread, 13.97 m (45 ft. 10 in)
- Height: 4.82 m (15 ft. 9.75 in)
- Wing area: 37.35 m² spread, 34.16 m² swept (402.05 ft² / 367.71 ft²)
- Empty weight: 9,595 kg (21,153 lb.)
- Loaded weight: 15,700 kg (34,612 lb.)
- Max takeoff weight: 18,030 kg (39,749 lb.)
- Powerplant: 1× Tumansky R-27F2-300 afterburning turbojet, 65.7 kN dry, 10 kN afterburning (14,450 lb. / 22,000 lb.)

Above, the R-29-300. Source: Georg Mader. Below, a Libyan Air Force MiG-23 on jacks during a landing gear checks while undergoing a Depot-level overhaul in the Ukraine. Note the open and empty drag parachute compartment and the folded fuselage fin under the tail. Source: Georg Mader.

Cockpit view of a Bulgarian Air Force MiG-23BN single-seater. Note the white vertical line painted on the instrument panel. This line was used as a reference for the pilot in case of a loss of control/spin. In such a case, the pilot would center the stick on the line as part of the recovery attempt. Also visible on the right-hand side, are the annunciator panels. Source: Alexander St. Alexandrov. Copyright © 2007.

MiG-23/MiG-27 Versions and Variants

First Generation

- **Ye-231** ("Flogger-A") was the prototype built for testing, and it lacked the saw tooth leading edge that later appeared on all MiG-23/-27 models. This experimental model was the common basic design that both the MiG-23/-27 and Sukhoi Su-24 were based on, but the Su-24 experienced much greater modification.

- **MiG-23** ("Flogger-A") was the pre-production model that lacked the hard points on later production versions, but the saw tooth leading edge appeared on this model, and it was also armed with guns. This model marked the divergence of the MiG-23/-27 and Su-24 from their common ancestor.

- **MiG-23S** ("Flogger-A") was the initial production variant. Only around 60 were built between 1969 and 1970. These aircraft were used for both flight and operational testing. The MiG-23S had an improved R-27F2-300 turbojet engine with a maximum thrust of 9,980 kg. As the Sapfir-23 radar was delayed, the aircraft were installed with the S-21 weapons control system with the RP-22SM radar—basically the same weapons system as in the MiG-21MF/bis. A twin-barreled 23 mm GSh-23L gun with 200 rounds of ammunition was fitted under the fuselage. This variant suffered from various teething problems and was never fielded as an operational fighter.

- **MiG-23SM** ("Flogger-A") was the second pre-production variant, which was also known as the MiG-23 Type 1971. It was considerably modified compared to the MiG-23S: it had the full S-23 weapons suite, featuring a Sapfir-23L radar coupled with Vympel R-23R (NATO: AA-7 "Apex") BVR missiles. It also had a further improved R-27F2M-300 (later re-designated Khatchaturov R-29-300) engine with a maximum thrust of 12,000 kg. The modified "type 2" wing had an increased wing area and a larger saw tooth leading edge. The slats were deleted and wing sweep was increased by 2.5 degrees; wing positions were changed to 18.5, 47.5, and 74.5 degrees, respectively. The tail fin was moved further aft, and an extra fuel tank was added to the rear fuselage, as in the two-seat variant (see below). Around 80 examples were manufactured. The overall reliability was increased over the previous variant, but the "Sapfir" radar still proved to be immature.

- **MiG-23M** ("Flogger-B") This variant first flew on June 1972. It was the first truly mass-produced version of the MiG-23, and the first VVS fighter to feature look-down/shoot-down capabilities (although this capability was initially very limited). The wing was modified again and now featured leading-edge slats. The Tumansky R-29 (R-29A) engine was now rated for 12,500 kg. It finally had the definitive sensor suite: an improved Sapfir-23D (NATO: 'High Lark') radar, a TP-23 infra-red search and track (IRST) sensor and an ASP-23D gun sight. The "High Lark" radar had a detection range of some 45 km against a high-flying, fighter-sized target. It was not a true Doppler radar but instead utilized the less effective "envelope detection" technique, similar to some radars on Western fighters of the 1960s.

Above, a detailed front view of a Libyan Air Force MiG-23ML *in 2006. The complex landing gear system and the swept wing are clearly visible.* Source: Chris Lofting. *Copyright © 2006. www.airliners.net. Below, another Libyan Air Force MiG-23, this time a UB (two-set) version photographed in 2007. The MiG-23UB is the most common version and variant of the aircraft in the US. Source: Chris Lofting. Copyright © 2006. www.airliners.net.*

- **MiG-23MF** ("Flogger-B") This was an export derivative of the MiG-23M originally intended to be exported to Warsaw Pact countries, but it was also sold to many other allies and clients, as most export customers were dissatisfied with the rather primitive MiG-23MS. It actually came in two versions. The first one was sold to Warsaw Pact allies, and it was essentially identical to Soviet MiG-23M, with small changes in "identify friend or foe" (IFF) transponders and communications equipment. The second variant was sold outside Eastern Europe and it had a different IFF and communications suite (usually with the data link removed), and downgraded radar, which lacked the electronic counter-countermeasure (ECCM) features and modes of the baseline "High Lark". This variant was more popular abroad than the MiG-23MS and considerable numbers were exported, especially to the Middle East.

  The infrared system had a detection range of around 30 km against high-flying bombers, but less for fighter-sized targets. The aircraft was also equipped with a Lasur-SMA data link. The standard armament consisted of two radar- or infrared-guided Vympel R-23 (NATO: AA-7 "Apex") BVR missiles and two Molniya R-60 (NATO: AA-8 "Aphid") short-ranged infrared missiles. From 1974 onwards, double pylons were installed for the R-60s, enabling up to four missiles to be carried. Bombs, rockets, and missiles could be carried for ground attack. Later, compatibility for the radio-guided Kh-23 (NATO: AS-7 "Kerry") ground-attack missile was added. Most Soviet MiGs were also wired to carry tactical nuclear weapons. Some 1,300 MiG-23Ms were produced for the VVS and Soviet Air Defense Forces (*PVO Strany*) between 1972 and 1978. It was the most important Soviet fighter type from the mid-to-late 1970s.

- **MiG-23U** ("Flogger-C") The MiG-23U was a twin-seat training variant. It was based on the MiG-23S, but featured a lengthened cockpit with a second crew station behind the first. One forward fuel tank was removed to accommodate an extra seat; this was compensated for by adding a new fuel tank in the rear fuselage. The MiG-23U had the S-21 weapon system, although the radar was later mostly removed. During its production run, both its wings and engine were improved to the MiG-23M standard. Production began at Irkutsk in 1971 and eventually converted to the MiG-23UB.

- **MiG-23UB** ("Flogger-C") Very similar to MiG-23U except that the Tumansky R-29 turbojet engine replaced the older R-27 installed in the MiG-23U. Production continued until 1985 (for the export variant). A total of 769 examples were built, including conversions from the MiG-23U.

- **MiG-23MP** ("Flogger-E") Similar to the MiG-23MS (described below), but produced in much fewer numbers and was never exported. Virtually identical to MiG-23MS except the addition of a dielectric head above the pylon, which was often associated with the ground-attack versions—for which it might have been a developmental prototype.

- **MiG-23MS** ("Flogger-E") This was an export variant, as the 1970s MiG-23M was considered too advanced to be exported to Third World countries. It was otherwise similar to MiG-23M, but it had the S-21 standard weapon system, with a RP-22SM (NATO: "Jay Bird") radar in a smaller radome, and the IRST was removed. Obviously, this variant had no BVR capability, and the only air-to-air missiles it was capable of using were the R-3S (NATO: AA-2 "Atoll") and

R-60 (NATO: AA-8 “Aphid”) IR-guided missiles and the R-3R (NATO: AA-2 “Atoll”) semi-active radar homing (SARH) missile. The avionics suite was very basic. This variant was produced between 1973 and 1978 and exported principally to North Africa and the Middle East.

Second Generation

- **MiG-23P** (“Flogger-G”) This was a specialized air-defense interceptor variant developed for the PVO Strany. It had the same airframe and powerplant as the MiG-23ML, but there is a cut-back fin root fillet instead of the original extended one on other models. Its avionics suite was improved to meet PVO requirements and mission profiles. Its radar was the improved Sapfir-23P, which could be used in conjunction with the gun sight for better look-down/shoot-down capabilities to counter increasing low-level threats like cruise missiles. The IRST, however, was absent. The autopilot included a new digital computer, and it was linked with the Lasur-M data link. This enabled ground-controlled interception (GCI) ground stations to steer the aircraft towards the target; in such an intercept, all the pilot had to do was control the engine and use the weapons. The MiG-23P was one of the most numerous PVO interceptors in the 1980s. Around 500 aircraft were manufactured between 1978 and 1981. The MiG-23P was never exported and served only within the PVO in Soviet service.

- **MiG-23*bis*** (“Flogger-G”) Similar to the MiG-23P except the IRST was restored and the cumbersome radar scope was eliminated because all of the information it provided could be displayed on the new head-up display (HUD).

- **MiG-23ML**. The early “Flogger” variants were intended to be used in high-speed missile attacks, but it was soon noticed that fighters often had to engage in more stressful close-in combat. Early production aircraft had actually suffered cracks in the fuselage during their service career. Maneuverability of the aircraft was also criticized. A considerable redesign of the airframe was performed, resulting in the MiG-23ML (L – lightweight), which made it in some ways a new aircraft. Empty weight was reduced by 1,250 kg, which was achieved partly by removing a rear fuselage fuel tank. Aerodynamics was refined for less drag. The dorsal fin extension was removed. The lighter weight of the airframe resulted in a different sit on the ground, with the aircraft appearing more level when at rest compared to the nose-high appearance of earlier variants. This has led to a belief that the undercarriage was redesigned for the ML variant, but it is identical to earlier variants. The airframe was now rated for a g-limit of 8.5, compared to 8 g for the early generation MiG-23M/MF “Flogger-B.” A new engine model, the R-35F-300, now provided a maximum dry thrust of 8,550 kg, and 13,000 kg with afterburner. This led to a considerable improvement in maneuverability and thrust-to-weight ratio. The avionics set was considerably improved as well. The S-23ML standard included Sapfir-23ML radar and TP-23ML IRST. The new radar was more reliable and had maximum detection range of about 65 km against a fighter-sized target (25 km in look-down mode). The navigation suite received a new, much improved autopilot. New radio and data link systems were also installed. The prototype of this variant first flew in 1976 and production began 1978.

Russian Air Force MiG-23UB during landing in August 1992 while still based in Germany. Note the full span flaps and slats (leading edge) in the down position, retracted ventral fin, and extended rear seat periscope. Also visible are the safety and servicing markings and stencils throughout the airframe. Source: Chris Lofting. Copyright © 2013. Below, a high resolution photograph of a Czech Air Force MiG-23ML on the flight line in the 1990s. Note the full swept-back 72° angle of the wings. Also clearly visible is the air intake with the slit plate and horizontal guide vanes as are the pylons under the fuselage and in the wings. Chris Lofting. Copyright © 2013.

- **MiG-23MLA** (‘*Flogger-G*) The later production variant of the ML was re-designated the MLA. Externally, the “MLA” was identical to ML. Internally, the MLA had improved radar with better ECM resistance, which made co-operative group search operations possible as the radars would now not jam each other. It also had a new ASP-17ML HUD/gun sight, and the capability to fire improved Vympel R-24R/T missiles. Between 1978 and 1982, around 1,100 ML/MLAs were built for both the Soviet Air Force and export customers. As with the MiG-23MF, there were two different MiG-23ML sub-variants for export: the first version was sold to Warsaw Pact countries and was very similar to Soviet aircraft. The second variant had downgraded radar and it was sold to Third World allies.

- **MiG-23MLD** (“Flogger-K”) The MiG-23MLD was the ultimate fighter variant of the MiG-23. The main focus of the upgrade was to improve maneuverability, especially during high angles of attack (AOA). The pitot boom was equipped with vortex generators, and the wing’s notched leading edge roots were ‘saw-toothed’ to act as vortex generators as well. The flight-control system was modified to improve handling and safety in high-AOA maneuvers. Significant improvements were made in avionics and survivability. The Sapfir-23MLA-II featured improved modes for look-down/shoot-down and close-in fighting. A new SPO-15L radar warning receiver was installed, along with chaff/flare dispensers. The new and very effective Vympel R-73 (NATO: AA-11 “Archer”) short-range air-to-air missile was added to inventory. No new-build “MLD” aircraft were delivered to the VVS, as the more advanced MiG-29 was about to enter production. Instead, all Soviet “MLD” aircraft were former “ML/MLA” aircraft modified to “MLD” standard. Some 560 aircraft were upgraded between 1982 and 1985. As with earlier MiG-23 versions, two distinct export variants were offered. Unlike Soviet examples, these were new-build aircraft, though they lacked the aerodynamic refinements of Soviet MLDs; 16 examples were delivered to Bulgaria, and 50 to Syria. These were the last single-seat MiG-23 fighters made, and the last example rolled off the production line in December 1984.

Ground-Attack Variants

- **MiG-23B** (“Flogger-F”) The requirement for a new fighter-bomber had become obvious in the late 1960s, and the MiG-23 appeared to be suitable type for such conversion. The first prototype of the project, “32-34,” flew for the first time on 20 August 1970. The MiG-23B had a redesigned forward fuselage, but was otherwise similar to the MiG-23S. The pilot seat was raised to improve visibility, and the windscreen was armored. The nose was flat-bottomed and tapered down. There was no radar; instead it had a PrNK Sokol-23 ground attack sight system, which included an analog computer, a laser rangefinder, and the PBK-3 bomb sight. The navigation suite and autopilot were also improved to provide more accurate bombing. It retained the GSh-23L gun, and its maximum combat load was increased to 3,000 kg by strengthening the pylons. Survivability was improved by an electronic warfare (EW) suite and inert gas system in the fuel tanks to prevent fire. The first prototype had a MiG-23S type wing, but subsequent examples had the larger “type 2” wing. Most importantly, instead of an R-29 variant, aircraft was powered by the Lyulka AL-21 turbojet with a maximum thrust of 11,500 kg. The production of this variant was limited, however, as the supply of AL-21 engines was needed for the Sukhoi Su-17 and Su-24 production lines. In addition, this engine was not cleared for export. Only three MiG-23B prototypes and 24 production aircraft were produced in 1971–72.

- **MiG-23BK** (“Flogger-H”) These were exported to Warsaw Pact countries—but not to Third World customers—and thus had the PrNK-23 navigation and attack system. Additional radar warning receivers were also mounted on the intakes.

- **MiG-23BN** (“Flogger-H”) Produced since 1973, the MiG-23BN was based on MiG-23B, but had the same R-29-300 engine as contemporary fighter variants. They were also fitted with “type 3” wings. There were other minor changes in electronics and equipment, and some changes were made during its long production run. Serial production lasted until 1985, with 624 built. Most of them were exported, as the Soviets always viewed it as an interim type and only a small number served in Frontal Aviation regiments. As usual, a downgraded version was sold to Third World customers. This variant proved to be fairly popular and effective. The most distinctive identifying feature between the MiG-23B and MiG-23BN was that the former had the dielectric head just above the pylon, which was removed from the MiG-23BN. In India, the last MiG-23BNs were flown by 221 Squadron (Valiants) of Indian Air Force and were decommissioned on 6 March 2009. Wing Commander Tapas Ranjan Sahu was the last pilot to land the MiG-23BN on that day.

- **MiG-23BM** (“Flogger-D”) This was a MiG-23BK upgrade, with the PrNK-23M replacing the original PrNK-23, and a digital computer replacing the original analog computer. Introduced into service as MiG-27.

- **MiG-23BM Experimental Aircraft** (“Flogger-D”) The MiG-23 ground-attack versions had too much “fighter heritage” for an attack aircraft, and a new design with more radical changes was developed (later to be re-designated as the MiG-27). The MiG-23BM experimental aircraft served as a predecessor to the MiG-27 and it differs from the standard MiG-23BM and other MiG-23 models in that its dielectric heads were directly on the wing roots, instead of on the pylons.

- **MiG-27** (NATO: “Flogger-D”). Introduced in 1975, simplified ground-attack version with simple pitot air intakes, no radar, and a simplified engine with two position afterburner nozzle.

- **MiG-27K** (NATO reporting name: *Flogger-J2)*. The MiG-27K was most advanced variant Soviet version, with a laser designator and compatibility with TV-guided electro-optical weapons. It carried the GSh-6-30 cannon. Around 200 were built.

- **MiG-27M.** (NATO reporting name: *Flogger-J)*. This model was a cheaper variant than the MiG-27K, but much better than the MiG-23B, MiG-23BN, and MiG-27 (MiG-23BM), with the electro-optical and radio-frequency heads above the glove pylons deleted. It was first armed with the GSh-6-23M Gatling gun, but this was later replaced by a new 30 mm GSh-6-30 sixbarrel cannon with 260 rounds of ammunition in a fuselage gondola. It also received much-improved electronic countermeasure (ECM) systems, and a new PrNK-23K nav/attack system providing automatic flight control, gun firing, and weapons release. However, this modification was not very successful because of the heavy recoil from the new cannon, and bursts longer than two or three seconds often led to permanent damage to the airframe. A total of 200 MiG-27Ms were built from 1978 to 1983, plus 160 for India, and it is currently in service with the Sri Lanka Air Force.

- **MiG-27D.** All MiG-27D are MiG-27s (MiG-23BMs) upgraded to the MiG-27M standard. It is very difficult to distinguish from the MiG-27M. 305 were upgraded.

- **MiG-27ML.** This was an export variant of the MiG-27M provided in 1986 to India in knock-down kits for license-assembly. It was the same as the MiG-27M, except the under nose fairing for the infra-red search and track (IRST) sensor had a single window instead of several, like the one on the original MiG-27M. A total of 150 were assembled by India. India refers to this model as the MiG-27M *Bahadur*, while MiG-27L is the Mikoyan export designation.

- **MiG-27H.** This was a 1988 indigenous Indian upgrade of its license-assembled MiG-27L with French avionics, which provides the same level of performance, but with much reduced size and weight. The capabilities of the aircraft are being enhanced by the incorporation of modern avionics systems consisting primarily of two Multi-Function Displays (MFDs) Mission and Display Processor (MDP), Sextant Ring Laser Gyros (RLG INSI), combined GPS/GLONASS navigation, HUD with UFCP, Digital Map Generator (DMG), jam-resistant Secured Communication, stand-by UHF communication, data link and a comprehensive Electronic Warfare (EW) Suite. A mission planning and retrieval facility, VTR and HUD Camera will also be fitted. The aircraft retains stand-by (conventional) instrumentation, including artificial horizon, altimeter, and airspeed indicator, to cater for the failure of HUD and the MFDs. The MiG-27s are also being endowed with the French Agave or Russian Komar radar. The installation of the radar would give the MiG-27 anti-ship and some air-to-air capability. It is expected that at least 140 of the 180 aircraft will be converted from MiG-27MLs.

<u>Proposed Variants and Upgrades</u>

- **MiG-23R** was a proposed reconnaissance variant; the project was never finished.

- **MiG-23MLGD**. “MLG” and “MLS” were further fighter upgrades with new radar and EW equipment, partly the same as in MiG-29; these variants were also fitted with helmet-mounted sights and were basically MiG-23MLD sub-variants.

- **MiG-23K** was a carrier-borne fighter variant based on the MiG-23ML.

- **MiG-23A** was a multi-role variant based on the “K.” However, cancellation and subsequent redesign of the Soviet aircraft carrier project also caused cancellation of the MiG-23A and MiG-23K variants and sub-variants. It was planned to develop the MiG-23A into three different sub-variants:

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Above and below, two current views of Indian Air Force MiG-27s in flight. As a dedicated ground-attack version of the MiG-23, the MIG-27 continues to be a powerful strike aircraft. These photographs clearly illustrate the design function of the aircarft. Source: Indian Air Force.

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MiG-23AI The MiG-23AI was to be a dedicated fighter.
  - **MiG-23AB** The MiG-23AB was to be an attack-dedicated variant.
  - **MiG-23AR** a dedicated reconnaissance variant.

- **MiG-23MLK** Planned to be powered by either two new R-33 engines or one R-100.

- **MiG-23MD** Was basically a MiG-23M fitted with a Saphir-23MLA-2.

- **MiG-23ML-1** Was a variant with several possible powerplant and engine choices; its single-engine options were either one R-100 or one R-69F engine, while its twin-engine arrangement was two R-33 engines. It was planned to be armed with a new air-to-air missile, the R-146.

- **MiG-23-98** In the late 1990s, Mikoyan, following their successful MiG-21 upgrade projects, offered an upgrade which featured new radar, new self-defense suite, new avionics, improved cockpit ergonomics, helmet-mounted sight, and the capability to fire Vympel R-27 (NATO: AA-10 “Alamo”) and Vympel R-77 (NATO: AA-12 “Adder”) missiles. The projected cost was around US $1 million per aircraft. Smaller upgrades were also offered, which consisted of only improving the existing Sapfir-23 with newer missiles and upgrades of other avionics. Airframe life extension was offered as well.

- **MiG-23-98-2** An export upgrade including the “Saphir” radar fitted to their MiG-23MLs; this radar upgrade allows the Angolan MiG-23s to fire new types of air-to-air and air-to-ground weapons. This radar upgrade seems to be the same offered as part of the radar upgrade.

- **MiG-23LL** (flying laboratory) MiG-23s and MiG-25s were used as the first jet fighter platforms to test a new in-cockpit warning system with a prerecorded female voice to inform pilots about various flight parameters. A female voice was chosen specifically to provide a clear and intuitive distinction between communications from the ground and the messages from internal systems, since ground communications virtually always came in male voice in Soviet service.

Current MiG-23 Operators

Angola: National Air Force of Angola; 32 MiG-23ML/UB in service.

Cuba: Cuban Air Force. The Cuban Air Force received a total of 69 MiG-23ML/MF/BN/UB.

Ethiopia: Ethiopian Air Force; 32 MiG-23BN/UBs in service for ground attack role. The interceptor variant, MIG-23ML, was withdrawn from service.

Iraq: Iraq Air Force; 20 aircraft.

Libya: Libyan Air Force; had 130 MiG-23MS/ML/BN/UBs in service.

North Korea: North Korean Air Force; 66 MiG-23ML/UBs in service.

Above, a Czech Republic Air Force MiG-23BN taxiing to runway before the last flight in May 1994. Below, another MiG-23BN undergoing maintenance in 1993. Source: Petr Pribyl. Copyright © 2013.

Above, a Czech Republic Air Force MiG-23ML undergoing maintenance in 1997. Below, a Czech Republic Air Force MiG-23BN on jacks during testing while ground powered. Note the extended ventral fin, which extends only in flight. Source: Source: Petr Pribyl. Copyright © 2011.

Sri Lanka: Sri Lanka Air Force; one MiG-23UB trainer used only for training purposes for their MiG-27 fleet.

Sudan: Sudanese Air Force; 30 MiG-23BN/UBs in service.

Syria: Syrian Air Force; 146 MiG-23MS/MF/ML/MLD/BN/UB in service.

Yemen: Yemen Air Force; 44 MiG-23BN/UBs in service.

Zimbabwe: Air Force of Zimbabwe; three MiG-23M/UBs were seen in a fly past in 2003.

Former MiG-23 Operators

Armenia: Armenian Air Force.

Afghanistan: Afghan Air Force. MiG-23BN/UBs may have served with the Afghan Air Force from 1984. It is unclear whether these were merely Soviet aircraft wearing Afghan colors.

Algeria: Algerian Air Force.

Belarus: Belarus Air Force.

Bulgaria; Bulgarian Air Force. A total of 90 MiG-23s served the Bulgarian Air Force from 1976 to their withdrawal from service in 2004. The exact count is: 33 MiG-23BNs, 12 MiG-23MFs, 1 MiG-23ML, eight MiG-23MLAs, 21 MiG-23MLDs, and 15 MiG-23UBs.

Czech Republic: Czech Air Force. The MiGs were retired in 1994 (BN, MF version) and 1998 (ML, UB variant).

Czechoslovakia: Czechoslovakian Air Force. MiG-23s were transferred to the Czech Republic.

East Germany: East German Air Force; transferred to (West) German Air Force. The German Air Force gave two MiG-23s to USAF and one to a museum in Florida; the others were given away to others states or scrapped.

Egypt: Egyptian Air Force. At least eight were transferred to USA for evaluation.

Germany: German Air Force. In 1990 the West German Air Force inherited 18 MiG-23BNs, 9 MiG-23MFs, 28 MiG-23MLs, and MiG-23UBs from East Germany.

Hungary: Hungarian Air Force. 16 MiG-23s served and were withdrawn in 1997; the exact count is: 12 MiG-23MFs and four MiG-23 UBs (one of them was purchased in 1990 from the Soviet Air Force).

India: Indian Air force. The MiG-23BN ground attack aircraft was phased out on 6 March 2009 and the MiG-23MF air defense interceptor phased out on 2007. A total of 40 MiG-23MF, 95 MiG-23BN, and 15 MiG-23UB had been obtained.

Above, a Czech Republic Air Force MiG-23ML in September 1995. Note the drag chute on the ground, behind the aircraft, ready for installation in the drag chute compartment above the exhaust nozzle. Source: Petr Pribyl. Copyright © 2013. Below, a MiG-27M is one of the seven of this type operational at the Sri Lanka Air Force. Note the pylons on the wings and under the fuselage. Also, the MiG-27 does not have the splitter plate in the air intake like the MiG-23. Source: Frank Noort. Copyright © 2011.

Ivory Coast: Cote d'Ivoire Air Force; received two MiG-23MLDs from Bulgaria in the late 1990s.

Kazakhstan: Military of Kazakhstan. A total of 100 MiG-23M/UB were in service.

Libya: Libyan Air Force; had 130 MiG-23MS/ML/BN/UBs in service (most in storage) prior to the 2011 Libyan civil war. What remains has been passed on to the successor government.

Poland: Polish Air Force. A total of 36 MiG-23MF single-seaters and six MiG-23UB trainers were delivered to the Polish Air Force between 1979 and 1982. The last of them were withdrawn in September 1999.

Namibia: Namibian Air Force; had two MiG-23 aircraft in service.

Romania: Romanian Air Force. A total of 46 MiG-23 served from 1979 until 2001 and were withdrawn in 2003; the exact count is: 36 MiG-23MF and 10 MiG-23 UB.

Russia: Russian Air Force. Approximately 500, all in reserve.

Somalia: Somali Air Force.

Turkmenistan: Military of Turkmenistan.

Soviet Union: Passed on to successor states.

Ukraine: Ukrainian Air Force.

Uzbekistan: Military of Uzbekistan 31 in service.

Zambia: Military of Zambia.

MiG-27 Operators

Cuba: The Cuban Air Force received 15 MiG-27s.

India: Indian Air Force 165 MiG-27Ms licensed built by HAL. To be retired by 2017.

Kazakhstan: Kazakh Air and Air Defense Forces : An estimated 40 MiG-23UB/MiG-27 are still operational.

Russia: The Russian Air Force retired their aircraft from front-line use. They are still in reserve (stored).

Soviet Union: The Soviet Air Force passed their aircraft on to successor states.

Sri Lanka: Sri Lanka Air Force : 7 in service bought from Ukraine.

Ukraine: The Ukrainian Air Force has retired their aircraft.

Above, a Romania Air Force MiG-23 in open storage in 2006. Source: Chris Lofting. Copyright © 1992. www.airliners.net. Below, a Czech AF MiG-23 armed with radar guided and infrared air-to-air missiles. Source: Georg Mader. Copyright © 2013.

Soviet MiG-23UB photographed in Germany in 1992. Source: Chris Lofting. Copyright © 1992. www.airliners.net.

Two East German Air Force MiG-23s photographed from a MiG-23UB in 1990. Source: Dr. Stefan Petersen. Copyright © 1990. www.airliners.net.

Above, a Sri Lankan Air Force MiG-27 photographed in flight. Note the wings in the intermediary 45° position, used for maneuvering. Source: Sri Lankan Air Force. Below, a frontal view of another Sri Lankan Air Force MiG-27. Several interesting points are illustrated by the photograph. First, the wings are in the 16° position, used for take-off, landing, and cruise. Second, the slats are extended, indicating that this photograph was taken during slow flight. Third, the note the asymmetric movement of the stabilizers, which, along with the wing-mounted spoilers, provide roll authority in the MiG-23 and MiG-27. Source: Sri Lankan Air Force.

Issue #	Issue(s)	Recommended Review, Action(s), and Coordination with Applicant	Notes, Action(s) Taken, and Disposition
MiG-23 Preliminary and General Airworthiness Inspection Issues			
1.	Aviation Safety (AVS) Safety Management System (SMS) Guidance	Use the AVS SMS guidance as part of the airworthiness certification process, as it supplements the existing Code of Federal Regulations (CFR). FAA Order VS8000.367 (May 14, 2008) and FAA Order VS8000.369 (September 30, 2008) are the basis for, but not limited to (1) identifying hazards and making or modifying safety risk controls, which are promulgated in the form of regulations, standards, orders, directives, and policies, and (2) issuing certificates. AVS SMS is used to assess, verify, and control risks, and safety risk management is integrated into applicable processes. Appropriate risk controls or other risk management responses are developed and employed operationally. Safety risk management provides for initial and continuing identification of hazards and the analysis and assessment of risk. The FAA provides risk controls through activities such as the promulgation of regulations, standards, orders, directives, advisory circulars (AC), and policies. The safety risk management process (1) describes the system of interest, (2) identifies the hazards, (3) analyzes the risk, (4) assesses the risk, and (5) controls the risk. As Chris Kraft (NASA Flight Director) once put it "the responsibility of managing risk meant that we had to understand failures and not repeat them." Kraft, 2001.	
2.	Aircraft Familiarization	Become familiar with the MiG-23 before initiating the certification process. One of the first steps in any aircraft certification is to be familiar with the aircraft in question. Such knowledge, including technical details, is essential in establishing a baseline as the certification process moves forward.	
3.	Preliminary Assessment	Conduct a preliminary assessment of the aircraft to determine condition and general airworthiness. A Manufacturing Inspection District Office (MIDO) inspector may seek Flight Standards District Offices (FSDO) support as part of this process. Coordination between the offices may be essential in ensuring adequate technical expertise.	
4.	Assistance from Other Offices	Recommend that as part of the early review of the airworthiness certification being proposed, the ASI consider the need to seek assistance from other FAA offices. In some cases, assistance from a FSDO ASI with military aircraft maintenance background may be required. Similarly, a FSDO may ask a MIDO to assist with other matters related to the certification of the aircraft.	
5.	Condition for Safe Operation	The FAA inspector or authorized representative of the Administrator must evaluate the overall condition of the aircraft to determine it is in a condition for safe operation. This refers to the condition of the aircraft relative to wear and deterioration. This evaluation depends on information such as aircraft age, completeness of maintenance records, and the overall condition of the aircraft.	
6.	Main Safety Issues	The main goal of this document is to assist the FAA in eliminating preventable accidents and those accidents and incidents caused by well-known problems that were either not fixed operationally or require specific mitigation to be contained. In other words, unnecessary risks must be mitigated. This document addresses the following general safety concerns regarding former military high-performance aircraft: • Lack of consideration of inherent and known design failures; • Several single-point failures; • Lack of consideration for operational experience, including accident data and trends; • Operations outside the scope of the airworthiness certificate being sought; • Insufficient flight test requirements; • Unsafe and untested modifications; • Operations over populated areas (the safety of the non-participating public has not been properly addressed in many cases); • Operations from unsuitable airports; • High-risk passenger carrying activities taking place; • Ejection seat safety and operation not adequately addressed; • Weak maintenance practices to address low reliability of aircraft systems and engines; • Ignoring required inspection schedules and procedures; • Limited pilot qualifications, proficiency, and currency; • Weapon-capable aircraft not being demilitarized, resulting in unsafe conditions; • Extensive brokering; • Extensive use of unqualified Designated Airworthiness Representatives (DAR); • Accidents and serious incidents not being reported; and • Inadequate accident investigation data.	

Issue #	Issue(s)	Recommended Review, Action(s), and Coordination with Applicant	Notes, Action(s) Taken, and Disposition
7.	Denial	The FAA will provide a letter to the applicant stating the reason(s) for denial and, if feasible, identify which steps may be accomplished to meet the certification requirements if the aircraft does not meet them and the special airworthiness certificate is denied. If this should this occur, a copy of the denial letter will be attached to FAA Form 8130-6 and forwarded to AFS-750, and made a part of the aircraft's record.	
8.	Potential Reversion Back to Phase I	Notify the applicant that certain modifications to the aircraft will invalidate Phase II. These include: (a) structural modifications, (b) aerodynamic modifications, including externally mounted equipment except as permitted in the limitations issued, and (c) change of engine make, model, or power rating (thrust or horsepower). The owner/operator may return the aircraft to Phase I to flight test specific items as required. However, major modifications such as those listed above may require new operating limitations. Phase I may have to be expanded as well. In August 2012, the National Transportation Safety Board (NTSB) issued safety recommendations concerning a fatal accident of an experimental high-performance aircraft that had undergone extensive modifications. The NTSB noted "the accident airplane had undergone many structural and flight control modifications that were undocumented and for which no flight testing or analysis had been performed to assess their effects on the airplane's structural strength, performance, or flight characteristics. The investigation determined that some of these modifications had undesirable effects. For example, the use of a single, controllable elevator trim tab (installed on the left elevator) increased the aerodynamic load on the left trim tab (compared to a stock airplane, which has a controllable tab on each elevator). Also, filler material on the elevator trim tabs (both the controllable left tab and the fixed right tab) increased the potential for flutter because it increased the weight of the tabs and moved their center of gravity aft, and modifications to the elevator counterweights and inertia weight made the airplane more sensitive in pitch control. It is likely that, had engineering evaluations and diligent flight testing for the modifications been performed, many of the airplane's undesirable structural and control characteristics could have been identified and corrected." As part of the probable cause, the NTSB stated that "contributing to the accident were the undocumented and untested major modifications to the airplane and the pilot's operation of the airplane in the unique air racing environment without adequate flight testing." As a result of this investigation, the NTSB issued safety recommendations, including requiring "aircraft owners to provide an engineering evaluation that includes flight demonstrations and analysis within the anticipated flight envelope for aircraft with any major modification, such as to the structure or flight controls." Refer to *Modifications* and *Phase I Flight Testing* below.	
9.	Identify Aircraft Version and Sub-Variants	It absolutely necessary to identify the series of the MiG-23 aircraft in question. There are major differences among and between the different series of the MiG-23/MiG-27. In fact, as shown in attachment 2, the MiG-23 "line" is in fact a maze of versions, variants, and modifications. As such, these differences and their impact on the airworthiness of the aircraft must be addressed as part of certification. The AIP, SOPs, training and any other activity must be specific to the version and variant of the aircraft.	
10.	Soviet/Russian Manufacturer	Although the MiG-23 was designed by the Mikoyan-Gurevich Design Bureau (and built by related production facilities), and for many years, MiG could be designated as the manufacturer, since the fall of the Soviet Union, there have been significant changes in Russia with regards to the ownership of the "MiG" aircraft manufacturer. As such, it impacted the MiG-23. The most current designation for the MiG-23 manufacturer would be Russian Aircraft Corporation MiG (RAC-MiG). Previous names, many used in the 1990s and 2000s, include Moscow Aircraft Production Organization (MAPO), and Military Industrial Group-MAPO (MiG-MAPO). As a result, depending on the aircraft, and the circumstances, the "manufacturer" will be MiG, but the designation may change.	
11.	Origin of the Aircraft	Ask for information concerning the origin of the aircraft. This is critical for many reasons. The origin of the aircraft will have an impact not only in the maintenance and operations of the aircraft, but it will also guide other aspects, such as demilitarization, and documentation. Note: Single-seat MiG-23s were manufactured at the GAZ-30 Znamya Truda factory in Moscow while two-seaters were delivered from the GAZ-39 factory in Irkutsk.	
12.	MiG-23 vs. MiG-27	Except where provided, all references in this document to the MiG-23 are applicable to the MiG-27 as well.	
13.	Major Structural Components	Ask the applicant to identify and document the origin, condition, and traceability of major structural components.	
14.	Aircraft Records	Request and review the applicable military and civil aircraft records, including aircraft and engine logbooks. These must be in English.	
15.	Data Plate, Block Number and Serial Number	Verify the Soviet military identification plate is installed, and a translation available. Record all information contained on the identification plate. Block number and serial number, or Soviet equivalent, also need to be identified.	
16.	Aircraft Ownership	Establish and understand the aircraft's ownership status, which sets the stage for many of the responsibilities associated with operating the aircraft safely. There are many cases where former military aircraft are leased from other entities, and this can cloud the process. For example, if the aircraft is leased, the terms of the lease may be relevant as part of the certification because the lease terms may restrict what can be done to the aircraft and its operation for safety reasons.	
17.	FAA Records Review	Review the existing FAA airworthiness and registration files (EDRS) and search the Program Tracking and Reporting Subsystem (PTRS) for safety issue(s) and incidents.	

Issue #	Issue(s)	Recommended Review, Action(s), and Coordination with Applicant	Notes, Action(s) Taken, and Disposition
18.	PTRS Entries for Malfunctions and Defects Reports	If the applicant reports malfunctions and defects, make a PTRS entry accordingly. See *Reporting Malfunctions and Defects* below.	
19.	FAA Form 8100-1	Use FAA Form 8100-1 to document the airworthiness inspection. Using this form facilitates the listing of relevant items to be considered, those items' nomenclature, any reference (that is, NATO manual; FAA Order 8130.2, Airworthiness Certification of Aircraft and Related Products; regulations) revision, satisfactory or unsatisfactory notes, and comments. Items to be listed include but are not limited to— 1. FAA Form 8130-6; 2. 14 CFR § 21.193; 3. FAA Form 8050-1; 4. 14 CFR § 45.11(a); 5. FAA Order 8130.2, paragraphs 4002a(7) and (10), 4002b(5), 4002b(6), 4002b(8), 4111c, and 4112a(2); 6. 14 CFR § 91.205; 7. § 91.417(a)(2)(i), airframe records and total time, overhaul; and 8. § 91.411/91.413, altimeter, transponder, altitude reporting, static system test.	
20.	Airframe and Engine Data	Ask applicants to provide the following: Airframe: • Import country (if applicable), • N-Number, • Manufacture year and serial number, and • Airframe time and airframe cycles. Engine: • Type and variant, • Manufacture date and serial number, and • Overhaul data, location, provider, and engine time and cycles. Properly identifying the relevant and basic characteristics of the airframe and the engine are necessary to address the safety issues with the aircraft. The following excerpt from an NTSB report on a former military jet accident illustrates the seriousness of having adequate records: "On May 15, 2005, a British Aircraft Corporation 167 Strike Master MK 83, N399WH, registered to DTK Aviation, Inc., collided with a fence during an aborted takeoff from Boca Raton Airport, Boca Raton, Florida. The airplane was substantially damaged and the commercial-rated pilot and passenger sustained minor injuries. The pilot initially stated he performed a preflight inspection of the aircraft which included a flight control continuity check. He had the passenger disable the gust lock for the flight controls. He performed a flight control continuity check before taxiing onto the runway for takeoff; no discrepancies were reported. The takeoff roll commenced and at the calculated rotation speed (70 knots), he '...began to apply pressure to stick and noticed an unusual amount of load on the controls. I made a quick trim adjustment to ensure that the forces on the stick were not the results of aerodynamic loads. When the trim changes yielded no change, I initiated an abort (at approximately Vr at 80 knots) by retarding the throttle, extending the speed brakes, and applying the wheel brakes.' He notified the tower of the situation, briefed the passenger, and raised the flaps. He also opened the canopy after realizing that he was unable to stop on the runway. The airplane traveled off the end of the runway, rolled through a fence and came to rest upright. The pilot also stated that the airplane is kept outside on the ramp at the Boca Raton Airport. Examination of the airplane by an FAA operations inspector before recovery revealed the control column would only move aft between ¼ and ½ inch. No determination was made as to the position of the control lock in the cockpit. Examination of the airplane following recovery by an FAA airworthiness inspector revealed that the elevator was free to travel through the full range but was noted to be '...very stiff.' Additionally, the rudder was '...extremely hard to move in either direction." During movement of the elevator flight control surface, the rudder flight control surface was noted to move, and with movement of the rudder flight control surface, the elevator flight control surface was noted to move. A review of a United Kingdom Civil Aviation Authority (U.K. CAA) Mandatory Permit Directive (MPD) No. 2002-001 R1, issued on January 16, 2003, indicates "partial binding or complete seizure of the elevator/rudder concentric torque tube bearings causing an interconnect between elevator and rudder control systems. This interconnection has resulted in un-commanded rudder movement with the application of elevator control inputs and vice versa. Investigation has determined that bearing seizure was due to inadequate lubrication and water ingress in the elevator torque tube bearings. Aircraft subject to external storage are particularly prone to this occurrence. A review of the airplane maintenance records revealed the airplane was last inspection on June 29, 2004, in accordance with, '...the scope and detail of the inspection program approved by the FSDO for BAC Strikemaster dated June 29, 2001, and found it to be in safe operating condition at this time.' The logbook entry does not indicate airplane total time; therefore, the time since the inspection was not determined. There was no record that U.K. CAA MPD No. 2002-001 R1 had been complied with."	
21.	Functionality Check	Ask the applicant to prepare the aircraft for flight, including all preflight tasks, startup, run-up, and taxi. The procedures and technical guidance issued for the aircraft must be used.	

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22.	Accident and Incident Data System	Review the NTSB accident database and the FAA's Accident and Incident Data System for the aircraft type accidents and incidents. Refer to http://ntsb.gov and http://www.asias.faa.gov.	
23.	Accident and Incident History	Ask the applicant to provide any data concerning all accidents and/or incidents involving the aircraft.	
24.	Adequate Manuals and Related Documentation (in English)	Ensure the existence of a complete set of the applicable MiG-23 manuals, such as flight manuals, inspections and maintenance manuals, and engine manuals. Typically, this may involve over 100 such documents. An operator also needs to have the applicable technical guidance, equivalent to USAF T.O.s to address known issues related to airworthiness, maintenance, and servicing. The owner/operator is responsible for having complete list of all MiG-23 manuals [technical orders, maintenance manuals, parts catalogues, engine manuals, inspection schedules, flight manual(s), and checklists] with revisions if available, and ensuring they are added and properly referenced in any inspection program and operating guidance. Documentation must be provided in English. This is critical because (1) factory manuals are very ambiguous, and (2) many poorly translated documents are in circulation. Many earlier translations of Soviet military aircraft are inadequate and crude. Some operators do not even translate the cockpit instrumentation to English. Note: It is incorrect to assume that all MiG-23 manuals are interchangeable. Although the aircraft are similar in design, from a systems standpoint, and even from a flight characteristics perspective, there may be differences that have to be properly addressed. A complete list of applicable MiG-23 manuals includes— 1. *MiG-23 Flight Manual;* 2. *MiG-23UB Pilot's Operating Instructions, Version 5 – Flight Performance;* 3. *Instruction Book Concerning the Operational Particularities of the MiG-23UB Aircraft;* 4. *MiG-23 Inspection and Scheduled Maintenance Work;* 5. *MiG-23 Aircraft Inspection & Scheduled Maintenance Work, Part 111; and* 6. *Work Manual and MiG-23 Aircraft Structure and Engine Part 1.* 7. *Technical Description - Book One - Flying Characteristics MIG-23BN.* 8. *Technical Description - Book One - Flying Characteristics MIG-23UB.* 9. *Aerodynamic Features and Critical Flight Mode Behavior of the MiG-23.* 10. *Instructions for Pilots for the MIG-23UB, 1977.* 11. *MIG-23U Description, Operating and Maintenance Instructions Book 1, Parts 1 and 2. Publication RK-245B Book 1.* 12. *MIG-23UB Pilots Operating Instructions, Version B, Flight Performance.*	
25.	Indian Air Force (IAF) Technical Guidance	Because the availability of adequate technical manuals for MiG-23s imported from former Soviet block countries may not be adequate, consideration may be given to use applicable technical guidance and material from the IAF, which is the largest user of the aircraft.	
26.	MiG-23 NATO Guidance	Although the last operators of the MiG-23 in Europe retired the aircraft at about the same time those countries joined NATO, recommend the applicant seek any NATO guidance affecting the operation of the MiG-23 aircraft within those air forces post-1999. The countries involved include Bulgaria, the Czech Republic, and Poland.	
27.	USAF MiG-23 Data	Ensure the applicant uses all of the relevant USAF technical and operational guidance that was declassified in 2007 concerning the use of MiG-23 aircraft by the USAF between 1979 and the later 1980s. This provides an acceptable baseline for the FAA.	
28.	Applicant/Operator Capabilities	Review the applicant/operator's capabilities, general condition of working/storage areas, availability of spare parts, and equipment.	
29.	Scope and Qualifications for Restoration, Repairs, and Maintenance	Familiarize yourself with the scope of the restoration, repairs, and maintenance conducted by or for the applicant.	
30.	Limiting Duration of Certificate	Refer to § 21.181 and FAA Order 8130.2, regarding the duration of certificates, which may be limited. An example would be to permit operations for a period of time to allow the implementation of a corrective action or changes in limitations. In addition, an ASI may limit the duration if there is evidence additional operational requirements may be needed at a later date.	
31.	Compliance With § 91.319(a)(1)	Inform the operator that the aircraft are limited under this regulation. The aircraft cannot be operated for any purpose other than the purpose for which the certificate was issued. For example, in the case of an experimental exhibition certificate, the certificate can be used for air show demonstrations, proficiency flights, and flights to and from locations where the maintenance can be performed. Such a certificate is NOT IN EFFECT for flights related to providing military services (that is, air-to-air gunnery, target towing, electronic countermeasures (ECM) simulation, cruise missile simulation, and air refueling). Also refer to *Military/Public Aircraft Operations* below.	

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32.	Multiple Certificates	Ensure the applicant submits information describing how the aircraft configuration is changed from one to the other in those cases involving multiple airworthiness certificates. This is important because, for example, some research and development (R&D) activities may involve equipment that must be removed to revert back to the exhibition configuration (refer to R*&D Airworthiness Certification* below). Moreover, the procedures should provide for any additional requirement(s), such as additional inspections, to address situations such as high-G maneuvering that could impact the aircraft and/or its operating limitations. Similarly, it should address removing R&D equipment that could be considered part of a weapon system (refer to *Demilitarization* below). All applications for an R&D certificate must adhere to FAA Order 8130.29, Issuance of a Special Airworthiness Certificate for Show Compliance and/or Research and Development Flight Testing.	
33.	Public Aircraft Operations, State Aircraft Operations, Military Support Missions, DOD contracts	The special airworthiness certificate and attached operating limitations for this aircraft are not in effect during public aircraft operations (PAO) as defined by Title 49 of the United States Code (49 U.S.C.) §§ 40102 and 40125. They are also not in effect during state aircraft operations, (typically military support missions or military contracts), as defined by Article 3 of the International Civil Aviation Organization's (ICAO) Convention on International Civil Aviation. *Aircraft used in military services are deemed state aircraft.* Also refer to *Operations Overseas* below.	
34.	Re-Conforming to Civil Certificate	Following a public, state, or military aircraft operation, ensure the aircraft is returned, via an approved method, to the condition and configuration at the time of airworthiness certification before operating under the special airworthiness certificate issued following a public, state, or military aircraft operation. This action must be documented in a log or daily flight sheet. Ensure the applicant submits information describing how the aircraft configuration is changed from PAO, state aircraft, or other non-civil classification or activity back to a civil certificate. This is important because, for example, some military support activities may involve equipment or maneuvers that must be removed or mitigated to revert back to original Exhibition or R&D configuration. Moreover, the procedures should provide for any additional requirement(s), such as additional inspections, to address situations such as high-G maneuvering and sustained Gs that could have an impact on the aircraft and/or its operating limitations. Similarly, it should address removing equipment that could be considered part of a weapon system. Refer to *Demilitarization* below.	
35.	R&D Airworthiness Certification	R&D certification requires a specific project. Ensure the applicant provides detailed information such as— • Description of each R&D project providing enough detail to demonstrate it meets the regulatory requirements of § 21.191(a); • Length of each project; • Intended aircraft utilization, including the number of flights and/or flight hours for each project; • Aircraft configuration; • Area of operation for each project; • Coordination with foreign CAA, if applicable; and • Contact information for the person/customer that may be contacted to verify this activity. Note: All applications for an R&D certificate should include review of FAA Order 8130.29.	
36.	Temporary Extensions	Field offices should not consider temporary extensions of existing MiG-23 airworthiness certificates.	

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37.	Demilitarization	Verify the aircraft has been adequately demilitarized. This aircraft must remain demilitarized for all civil operations. Refer to the applicable technical guidance. A weapon, a weapon system, and related equipment can create safety of flight hazards under the jurisdiction of the FAA and must be removed. Removal of the Gryazev-Shipunov GSh-23L 23 mm cannon alone does not suffice. Other systems include: gun sight, pylons and wiring (in the case of wiring, the firing circuitry must not have any continuity to it), radar (made INOP), chaff, flares or practice bombs, ECM/Jamming gear, firing control (armament) panel(s), switches and triggers, and combing computers and systems. Some of the specific MiG-23 weapons system, depending on the model include: - ASP-PFD gun sight; - Sapfir-23MLA-II radar; - SPO-15L radar warning receiver; - TP-23-1 infra-red search and track (IRST) system; - Klyon-PM (Maple-PM)Laser Range Finder/Designator; - DZ-U-1A (rear fuselage) and MBD-3-U2T-1 racks (wing glove); - UB-16-57, UB-32 rocket launchers; - AVM-23 weapons control computer; - Lasur-M data link; - PrNK-23K navigation and attack system; - SPS-141 ECM system; With these systems, there are many safety issues that can preclude a finding of “condition for safe operation,” and “protecting people and property on the ground,” as required by statute and regulations. These safety issues include accidental firing, compartment fires, inadvertent discharge of flares, toxic chaff, electrical overloads of the aircraft electric system, danger of inadvertent release, structural damage to the aircraft, complex flight limitations, and harmful emissions. Note: Some of these weapon systems could be permitted for a R&D airworthiness certificate, but the related safety issues still have to be addressed, especially if the aircraft reverts back to an exhibition certificate. TO 00-80G-1, Make Safe Procedures for Public Static Display, dated November 30, 2002, can be used as a reference as well.	
38.	Chuguyev MiG-23 Demilitarization	Ask whether the aircraft was demilitarized by the Chuguyev Aircraft Repair Plant, in the Ukraine. If so, review the documentation associated with this process. If not, recommend that their assistance be considered if any questions arise on a particular process or systems (weapons system). This company also specializes in MiG-23 overhauls, and thus their expertise in demilitarizing the aircraft is relevant. See *UKHW MiG-23 Overhaul* below.	
39.	Safety Discretion	The field inspector may add any requirements necessary for safety. Under existing regulations and policies, FAA field inspectors have discretion to address any safety issue that may be encountered, whether or not it is included in the job aid. Of course, in all cases, there should be justification for adding requirements. In this respect, the job aid provides a certain level of standardization to achieve this, and in addition, AIR-200 is available to coordinate a review (with AFS-800 and AFS-300) of any proposed limitations an inspector may consider adding or changing. 49 U.S.C. § 44704 states that before issuing an airworthiness certificate, the FAA will find that the aircraft is in condition for safe operation. In issuing the airworthiness certificate, the FAA may include terms required in the interest of safety. This is supported by case law. 14 CFR § 21.193, Experimental Certificates: General requires information from an applicant, including, “upon inspection of the aircraft, any pertinent information found necessary by the Administrator to safeguard the general public.” 14 CFR § 91.319 *Aircraft Having Experimental Certificates: Operating* provides “the Administrator may prescribe additional limitations that the Administrator considers necessary, including limitations on the persons that may be carried in the aircraft.” Finally, FAA Order 8130.2, chapter 4, Special Airworthiness Certification, effective April 16, 2011, also states the FAA may impose any additional limitations deemed necessary in the interest of safety.	
40.	2009 Crash of ZU-BEX	Recommend the accident report concerning the 2009 Lightning T5 ZU-BEX be reviewed in detail. This report, published by the South African CAA in August 2012, provides valuable insight into the consequences of operating complex and high-performance former military aircraft in an unsafe manner. The relevant issues identified in the report include (1) ignoring operational history and accident data, (2) inadequate maintenance practices, (3) granting extensions on inspections, (4) poor operational procedures, and (5) inadequate safety oversight. Many of the issues discussed and documented in the accident investigation report are directly relevant to safety topics discussed in this airworthiness review document. The South African CAA report can be found at http://www.caa.co.za/.	

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41.	Importation	Review any related documents from U.S. Customs and Border Protection and the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) for the aircraft. If the aircraft was not imported as an aircraft, or if the aircraft configuration is not as stated in Form ATF-6, it may not be eligible for an airworthiness certificate. There are many cases in which Federal authorities have questioned the origin of former military aircraft and its installed weapon system. Some have been seized. For example, two T-28s were seized at the Canadian border by U.S. Customs officials in 1989. Refer to Federal Firearms Regulations Reference Guide, ATF Publication 5300.4, and Revised September 2005, for additional guidance. Note: In 1992, a Russian unit sold a MiG-23MLD to a company in Finland for display purposes, only. A U.S. citizen from Florida bought the jet from the Finnish company and imported it into the country, apparently hoping to fly the aircraft in air shows. Unfortunately for him, he brought the aircraft's GSh-23L 23-mm cannon into the country illegally, and consequently lost both the gun and aircraft to the U.S. government after the ATF seized them. The Foreign Materiel Exploitation Facility of the National Air Intelligence Center (NAIC) became the fighter's home until 1998, when the Center notified the Air Force Museum that the Flogger would become available for transfer to its collection.	
42.	Brokering	Verify the application for airworthiness does not constitute brokering. Section 21.191(d) was not intended to allow for the brokering or marketing of experimental aircraft. This includes individuals who manufacture, import, or assemble aircraft, and then apply for and receive experimental exhibition airworthiness certificates so they can sell the aircraft to buyers. Section 21.191(d) only provides for the exhibition of an aircraft's flight capabilities, performance, or unusual characteristics at air shows, and for motion picture, television, and similar productions. Certificating offices must verify all applications for exhibition airworthiness certificates are for the purposes specified under § 21.191(d) and are from the registered owners who will exhibit the aircraft for those purposes. Applicants must also provide the applicable information specified in § 21.193.	
43.	Restrictions on Operations Overseas	Inform the applicant/operator that operations may be restricted and permission must be granted by a foreign CAA. The applicable CAA may impose any additional limitations it deems necessary, and may expand upon the restrictions imposed by the FAA on the aircraft. In line with existing protocols, the FAA will provide the foreign CAA any information, including safety information, for consideration in evaluating whether to permit the operation of the aircraft in their country, and if so, under what conditions and/or restrictions. It is also noted any operator offering to use a U.S. civil aircraft with an experimental certificate to conduct operations such as air-to-air combat simulations, ECM, target towing for aerial gunnery, and/or dropping simulated ordinances pursuant to a contract or other agreement with a foreign government or other foreign entity would not be doing so in accordance with any authority granted by the FAA as the State of Registry or State of the Operator. On the issue of operations overseas: ➢ Under international law, the aircraft will either be operated as a civil aircraft or a state aircraft. The aircraft cannot have a combined status. If the aircraft are to be operated with civil status, then they must have FAA-issued airworthiness certificates. If the applicant/operator is seeking experimental certificates for R&D or Exhibition purposes for the aircraft, and if the FAA issues (or renews) those certificates for the aircraft, then the only permissible operation of the aircraft as civil aircraft in a foreign country, is for an R&D or Exhibition purpose. The applicant/operator cannot be allowed to accomplish other purposes during the same operation, such as performing the contract for a foreign air force. This position is necessary to avoid telling an operator that any R&D or Exhibition activity could serve as a cover for a whole host of improper activities using an aircraft with an experimental certificate for R&D or Exhibition purposes, rendering the R&D or Exhibition limitation on the certificate meaningless. ➢ The R&D or Exhibition activity would be a pretext for the real purpose of the operation. Accordingly, in issuing experimental certificates for an R&D or Exhibition purpose, the FAA must make it clear that any other activities or purposes for the operation are outside the scope of permitted operations under the certificate. The FAA must also make clear that the operation as a civil aircraft requires the permission of the foreign civil aviation authority (CAA). In requesting that permission, the applicant/operator should advise the foreign aviation authority that the operation will be for an R&D or Exhibition purpose only and for no other purpose, including performing a contract for any foreign military organization. ➢ The applicant/operator must understand that if the foreign CAA asks FAA about the operation, the FAA will state "that the only permissible purpose of the operation is R&D or Exhibition, and an operation for any other purpose, even when conducted in conjunction with an R&D or Exhibition purpose, is outside the scope of the operations allowed under the certificate. ➢ If the applicant/operator operates the aircraft as state aircraft, then the national government of some country will have designated the aircraft as its state aircraft, and the host country, will have given the aircraft permission to operate through the issuance of a diplomatic clearance. That diplomatic clearance should include whatever terms and conditions that CAA deems necessary or appropriate for the operation. ➢ The aircraft, when operated as state aircraft, does not need an FAA airworthiness certificate, and the pilots of those aircraft do not need to hold FAA-issued airman licenses. ➢ If a country issues a diplomatic clearance for the operation of the aircraft, the aircraft would be deemed to be a state aircraft of the country requesting that clearance. Safety oversight would rest with the country that requested the diplomatic clearance.	

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44.	Federally Obligated Airport Access	Inform the operator that operations may be restricted by airports because of safety considerations. As provided by 49 U.S.C. § 47107(a), a federally obligated airport may prohibit or limit any given type, kind, or class of aeronautical use of the airport if such action is necessary for the safe operation of the airport or necessary to serve the civil aviation needs of the public. Additionally, per FAA Order 5190.6, FAA Airport Compliance Manual, the airport should adopt and enforce adequate rules, regulations, or ordinances as necessary to ensure safety and efficiency of flight operations and to protect the public using the airport. In fact, the prime requirement for local regulations is to control the use of the airport in a manner that will eliminate hazards to aircraft and to people on the ground. In all cases concerning airport access or denial of access, and based on FAA Flight Standards Service safety determination, FAA Airports is the final arbiter regarding aviation safety and will make the determination (Director's Determination, Final Agency Decision) regarding the reasonableness of the actions that restrict, limit, or deny access to the airport (refer to FAA Docket 16-02/08, FAA v. City of Santa Monica, Final Agency Decision; FAA Order 2009-1, July 8, 2009; and FAA Docket 16-06-09, Platinum Aviation and Platinum Jet Center BMI v. Bloomington-Normal Airport Authority).	
45.	Environmental Impact (Noise)	Inform the operator that operations may be restricted by airport noise access restrictions and noise abatement procedures in accordance with 49 U.S.C. § 47107. As a reference, refer to FAA Order 5190.6.	

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46.	Initial Contact Checklist	The following is a sample of the contents of an initial contact by an FAA field office to an applicant concerning a proposed certification. It addresses many of the major safety and risk issues with the aircraft and will assist in (1) preparing an airworthiness applicant, (2) making corrections and updating any previous application, and (3) documenting the level of airworthiness review. 1. Discuss item missing from the application. a. Program letter setting the purpose for which the aircraft will be used. i. Exhibition of aircraft flight capabilities, performance, unusual characteristics at air shows, motion picture, television and similar productions, and maintenance of exhibition flight proficiency, including flying to and from such air shows and productions. ii. Aircraft cannot be certified if the intention is to broker or sell the aircraft. iii. Aircraft photos. 2. Prepare aircraft and documentation for FAA inspection. a. Maintenance and modification records. b. Aircraft history and logbooks (airframe, engine, and components). c. Have the aircraft maintenance program ready for review and acceptance. d. Have operations and maintenance and supplements. e. Have crew qualifications ready for review (pilot, mechanics, A&P, IA). f. Be prepared to show spare parts records. g. Be prepared to accomplish preflight, ground checks, run-up, and taxi checks. h. Be prepared to demonstrate the aircraft has been demilitarized. i. Have records on status of ejection seats. j. Be prepared to discuss required ground support equipment and specialized tooling for maintenance. k. Be prepared to discuss and document the airframe fatigue life program compliance. l. Be prepared to discuss engine thrust measurement process. m. Be prepared to demonstrate oxygen system checks. n. If "G" suits are used be prepared to demonstrate serviceability. o. Have records for any fabricated parts and engineering documentation if required. p. Have records on flight control balancing. q. Have weight and balance records. r. Be prepared to discuss external stores. s. Be prepared to discuss Phase I test flights (recommended 10 hours). t. Have record of installed avionics. 3. Applicable regulations and ACs. a. §§ 21.93, 21.181, 21.193, 21.191(d), 23.1441, 43.3, 43.9, 45.11, 45.23(b), 45.25, 45.29, 91.205, 91.307, 91.319(a) (1), 91.407, 91.409(f) (4), 91.411, 91.413, 91.417, 91.1037, 91.1109, and AC 43-9, AC 91-79. 4. Items to discuss with applicant. a. Recommendation of establishing a minimum equipment list. b. Recommend establishing minimum pilot experience and proficiency, including (1) FAA PIC policy, training, (2) 10 to 15 hours of dual time, and (3) 3 hours per month, and five takeoffs and landings. c. Recommend establishing minimum runways length criteria for takeoff and landing. d. Discuss military use, that is, declaration of public use operations (PAO) and operating limitations.	

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MiG-23 Maintenance Manual(s), Aircraft Inspection Program (AIP), and Servicing			
47.	Changes to Aircraft Inspection Program (AIP)	Consider whether the FAA-accepted AIP is subject to revisions to address safety concerns, alterations, or modifications to the aircraft. Section 91.415, Changes to Aircraft Inspection Programs, requires that "whenever the Administrator finds that revisions to an approved aircraft inspection program under § 91.409(f)(4) or § 91.1109 are necessary for the continued adequacy of the program, the owner or operator must, after notification by the Administrator, make any changes in the program found to be necessary by the Administrator." As provided by § 91.415, review the submitted maintenance manual(s) and AIP. Work with the applicant to revise the AIP as needed based on any concerns identified in attachment 3 to this document. For example, an AIP can be modified to address or verify— • Consistency with the applicable military T.O.s for airframe, powerplant, and systems to verify replacement/interval times are addressed. • All AIP section and subsections include the proper guidance/standards (that is, T.O.s or Engineering Orders) for all systems, groups, and tasks. • No "on condition" inspections for items that have replacement times unless proper technical data to substantiate the change. • Ejection seat system replacement times are adhered to. No "on condition" inspections for rocket moors and propellants. Make the distinction between replacement times, that is, "shelf life" vs. "installed life limit." • Any deferred log is related to a listing of minimum equipment for flight (refer to *Minimum Equipment for Flight* below, and AFI 21-103); • Inclusion of document revision page(s).	
48.	AIP Is Not a Checklist	Ensure the AIP stresses it is not a checklist. This is important in many cases because the actual AIP is only a simple checklist and actual tasks/logbook entries say little of what was actually accomplished and to what standard. This is one of the major issues with some FAA-approved inspection programs, and stems from confusion about the different nature of (1) aircraft maintenance manuals, (2) AIPs, and (3) inspection checklists. Unless a task or item points to technical data (not just a reference to a manual), it is simply a checklist, not a manual. Ensure the AIP directs the reader to other references such as technical data, including references to sections and pages within a document (and revision level), that is, "AC 43-13, p. 318" or "inspection card 26.2." Records must be presented to verify times on airframe and engines, inspections, overhauls, repairs, and in particular, time in service, time remaining and shelf life on life limited parts. It is the owner's responsibility to ensure these records are accurate. Refer to Classic Jet Aircraft Association (CJAA) Safety Operations Manual, Rev. 6/30/08.	
49.	AIP Limitations	Refrain from assuming compliance with the applicable military standards, procedures, and inspections are sufficient to achieve an acceptable level of safety for civil operations, as part of the airworthiness certification and related review of the AIP. This may not be true, depending on the situation and the aircraft. For example, an AIP based on 1976 Bulgarian AF requirements does not necessarily address the additional concerns or issues 35 years later, such as aging, structural and materials deterioration, stress damage (operations past life limits), extensive uncontrolled storage, new techniques, and industry standards.	
50.	AIP Revision Records and Log of Revisions	As part of the AIP, ensure the applicant/operator retains a master list of all revisions (log of revisions) that can be reviewed in accordance with other dated material that may be required to be done under a given revision. The AIP should address revision history for manual updates and flight log history. Relevant data includes: • Revision Number; • Date; • Page or Reference Numbers; • Initials and/or signature.	
51.	Maintenance Responsibilities	Ensure the AIP addresses responsibilities and functions in a clear manner. The AIP should address the difference between the aircraft owner and operator. The AIP also needs to address any leasing arrangement where maintenance is spilt or otherwise outside of the control of the applicant, that is, where maintenance is contracted to another party. The AIP should define the person responsible for maintenance. The AIP should address qualifications and delegations of authority, that is, whether the person responsible for maintenance has inspection authority and airworthiness release authority, or authority to return for service. In terms of inspection control and implementation, the AIP should define whether it is a delegation of authority, and if so, what authority is being delegated by the owner and operator. This has been an issue with the NTSB (and the Civil Aeronautics Board before it) since 1957.	
52.	Return to Service	Ensure the AIP clearly defines who can return the aircraft to service and provides minimum criteria for this authority. Follow the intent and scope of § 43.5, Approval for return to service after maintenance, preventive maintenance, rebuilding, or alteration; and § 43.7, Persons authorized to approve aircraft, airframes, aircraft engines, propellers, appliances, or component parts for return to service after maintenance, preventive maintenance, rebuilding, or alteration.	

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53.	Reliability-Centered Maintenance (RCM)	Provided that adequate technical data is part of any proposal for an alternative, RCM or Reliability Centered Maintenance, may be considered for certain items covered in the aircraft's AIP. With RCM the owner/operator continually analyzes aircraft conformity and airworthiness through surveillance and analysis and makes adjustments to the equipment's inspections and maintenance planning based on data. <u>There must be data</u>. With the adoption of RCM for certain components, the owner/operator of the aircraft, can continually adjust any program elements for operational safety and reliability and is evolving the inspections into a maintenance program by continually monitoring what needs to be inspected or replace at different times or in different ways or perhaps not at all. <u>Additional Information:</u> RCM is a program that needs to be properly documented and not a shallow determination that a particular inspection is not needed or an item need not be replaced. Moving to a RCM-based approach includes 4 objectives: (1) meet the designed safety and reliability expectations of the equipment, (2) restore safety and reliability to their required levels when deterioration of this has occurred, (3) obtain information needed for design improvement of items with reliability that is inadequate, and (4) compare these total costs and operational benefits with the former inspection program. RCM is based on: o A failure is an unsatisfactory condition; consequences of a functional failure determine the priority of maintenance effort; o Safety – Possible loss of equipment and occupants; o Hidden-failure – Multiple failures, resulting from undetected failure of a hidden function; o Scheduled maintenance – Required – Failure could have safety consequences; o Scheduled maintenance – Required – Failure not evident to the operating crew; o Safety Consequences – Reduced by the use of redundancy; o Hidden functions – Made evident by instrumentation or design features; o Feasibility – Effectiveness of scheduled maintenance depend on inspect ability; Inherent reliability of equipment is the level of reliability achieved with an effective maintenance program. This level is established by the design of each item and the manufacturer's processes that produced it. Scheduled maintenance can ensure that the inherent reliability of each item is achieved, but no form of maintenance supported by inspection and engineering data can yield reliability beyond that inherent in the design. A RCM program includes only what satisfies the criteria for applicability and effectiveness in terms of Applicability (determined by the characteristics of the item), and Effectiveness (defined by the consequences the task is designed to prevent). On-condition is also addressed, but data is used to determine and correct potential failures. Rework and overhaul, is an item at or before a specified limit, and has to be incorporated. Discard (an item at or before some specified life limit), and Failure-Finding (failures that occurred but not evident to the operator), are also part of a RCM program. The RCM includes Simple Items, which is one that is subject to very few failure modes, and frequently shows a decrease in reliability with increasing operational age or cycles, and Complex Items, which are those one whose failure may result from many different failure modes, shows little or no decrease in overall reliability with increasing age unless there is a dominant failure mode. RCM tasks are based on: o Consequences of each type of failure; Visibility of a functional failure to the operating crew (evidence a failure occurred); o Visibility or evidence a failure is imminent; Age-cycle reliability characteristics of each item; o Tradeoff between scheduled maintenance criteria and sampling, and life limiting items; o Multiple failure – Consequences that would not be caused by any one individual failure; o Default strategy – Provides for conservative initial decisions, revised with operating experience; Finally, RCM programs must be dynamic. The operating organization must be prepared to collect and respond to real data throughout the operational life of the equipment. This requires surveillance and analysis of the performance of each item under actual operating conditions to determine refinements and modifications to the program and to determine needs for product improvements.	
54.	Maintenance Practices	Consider AC 43.13-2, Acceptable Methods, Techniques, and Practices-Aircraft Alterations, and AC 43.13-1, Acceptable Methods, Techniques, and Practices-Aircraft Inspection and Repair, in addition to any guidance provided by the manufacturer/military service(s), to verify safe maintenance practices. In addition, TO 1-1A-1 *Engineering Handbook Series for Aircraft Repair, General Manual for Structural Repair*, dated November 15, 2006, should also be considered.	
55.	Qualifications for Inspections	Ensure only FAA-certificated repair stations and FAA-certificated mechanics with appropriate ratings as authorized by § 43.3 perform inspections on the aircraft.	
56.	Modifications	Verify major changes conform to the applicable guidance and do not create an unsafe condition, and determine whether new operating limitations may be required within the scope and intent of § 21.93. In addition, the information contained in appendix A to part 43 can be used as an aid. Refer to *Potential Reversion Back to Phase I* above.	
57.	Metric Conversions	The AIP and related documentation needs to provide for the adequate conversion of all metric units (i.e., charts, tables) used in the aircraft, its maintenance, and operations.	

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58.	Periodic Maintenance Inspection	Ensure compliance to Aircraft 23Y (MiG-23) Description, Operating and Maintenance Instructions No. TK-245B, with the daily, hourly, and calendar inspection requirements for the MiG-23.	
59.	LOK MiG-23 Overhaul	Ask if the aircraft was overhauled in the Czech Republic by LOK (Aviation Repair Plant) at Praha-Kbely. This state-owned company provided MiG-23 services. If this is the case, request and review the related documentation (in English) and how it compares with the inspection requirements for the aircraft in terms of hours and calendar times for example. The proper baseline needs to be established.	
60.	Yugoslav VTRZ Overhaul	Ask if the aircraft was overhauled by VTRZ (Vazduhoplovno Tehnički Remonti Zavod) at Zmaj, in Velika Gorica, near Zagreb (now Croatia. Although this company provided MiG-23 services to some froing air forces, like the Iraqi Air Force, it did not possess MiG-23 experience. Any work done was accomplished with assistance from the Hungarian Air Force and may not have been totally completed on all aircraft, in part because of both the 1991 Gulf War and the 1999 Balkan War that followed. The aircraft were never delivered and are sought ta have been stored extensively outdoors. If the aircraft in questions is represented as having received a VTRZ overhaul, request and review the related documentation (in English) and how it compares with the inspection requirements for the aircraft in terms of hours and calendar times for example. The proper baseline needs to be established.	
61.	HAL Spare Parts & Logistics	Hindustan Aeronautics Limited (HAL) in India manufactures and supplies the entire range of spares required for first and second-line servicing of MiG-23 aircraft at the IAF bases. Canopies, flexible rubber fuel tanks, main and nose undercarriages, ejection seats, and ground support/ground handling equipment are a few of the items supplied. The use of the parts, along with their documentation, will likely be acceptable in MiG-23 operations. In addition to other suppliers, especially in Eastern Europe, Hal may provide an alternative that will be acceptable. See http://hal-india.com/AircraftNasik/Services.asp.	
62.	SE Chuguivs'kyi Aircraft Repair Plant (Chuguyev, Ukraine) and MiG-23 Overhaul	Ask if the aircraft was overhauled in the Ukraine by UKHW SE Chuguivs'kyi Aircraft Repair Plant in Chuguyev. This state-owned company provides MiG-23 services for many of the former Soviet Union republics that still operate the aircraft. If this is the case, request and review the related documentation (in English) and how it compares with the inspection requirements for the aircraft in terms of hours and calendar times for example. The proper baseline needs to be established. For example, in 2011, the company overhauled several Kazakh-AF Floggers. Kazakhstan has been overhauling its MiG-27/23 UB in Ukraine since 2008. Angolan AF MiG-23s were also overhauled there in 2011. Similarly, Indian Air Force MiG-23UBs have also been overhauled by this company. Also see *Chuguyev MiG-23 Demilitarization* above. UKHW specializes in the repair of MiG-23 aircraft of all modifications since 1979. The company carries out the modernization of aircraft MiG-23. The company states that it "will provide specialized teams leave the territory of the customer for Troubleshooting and analysis of the aircraft, detect failures, and fault detection of the statements with the proposal of remediation plans. When repairing aircraft MiG-23, the company has an opportunity to increase the appointed time of service, perform the additional workload. The company offers: • Delivery of spare parts for aircraft; • Providing technical support aircraft during the warranty period; • Manufacturing equipment for sending the aircraft air and ground transportation and ground handling general and special purpose; • Execution of repair of individual units on the aircraft; • To provide consulting services on aircraft maintenance organization based on the customer; • Implementation of Modernization and aircraft equipment. See http://charz.com.ua/en/mig-23.html.	

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63.	Bulgarian Overhaul (Depot Level)	Ask if the aircraft (airframe & engine) was overhauled (Depot Level) in at TEREM - GEORGI BENKOVSKI (Aircraft Repair Plant), Plovdiv, Bulgaria. For example, an operator notes that "a depot-level overhaul in 1998 and was flying in Bulgaria as recently as 2002." http://www.cwam.org/wiki/index.php/MiG-23. If this is the case, request and review the related documentation (in English) and how it compares with the inspection requirements for the aircraft in terms of hours and calendar times for example. The fact that the aircraft may be an ex-Bulgarian Air Force aircraft does not mean that it received the life-extension program. The proper baseline (beyond the 1,500-hour limit) needs to be established since some (not all) of the ex-Bulgarian Air Force MiG-23s flew until November 2002. Some of the aircraft received a service life extension in early 2002, some did not. A MiG-23 overhaul was a lengthy process, lasting up to 4 months, and could cost up to $1 million. TEREM's provides services, including MiG-23 services to include: • Complete airframe overhaul and modernization the aircraft; • Repair of aircraft engines; • Repair of onboard power units and equipment; • Complete bodywork, anti-corrosion treatment and painting; • Extension of TBO and service life (time between overhauls); • Test trials of aircraft engines and power units; • Warranty and post-warranty technical maintenance support; • Supply of aircraft spare parts, power units and engines; • Production of technological equipment according to aircraft repair documentation; • Production of aircraft technical rubber mounting elements; Note: This company has approval certificates issued by the National Ministry of Defense, NATO, and Germanischer Lloyd for compliance with Part 145 of the Aviation Rules, AQAP2110, and ISO9001:2008 standards. See http://www.teremgb.bg/en/jets.html. Note: Many Ex-Romanian AF MiG-23s were overhauled at TEREM.	
64.	Indian Air Force 2010 MiG-27 Grounding Order (Lessons Learned)	Recommend the AIP incorporates the lessons learned from the 2010 IAF grounding of its MiG-27 fleet. This is important because the reason for the grounding and the results of the investigation(s) was mainly related to mechanical failures, especially the R-29 engine. As such, incorporation of what was learned into the AIP would be a worthwhile safety action in any civil operation of the MiG-23. Note: An IAF official noted in October 2012 that "we are planning to phase out the MiG-27s, of which around 80 are still in service, by the year 2017" in part because a "study was conducted to check the problems in the engines of the aircraft and it was found that the R-29s engines have developed some defect which was very difficult to be corrected. After the report, IAF took a considered decision about retiring these aircraft from operational service in a phased manner." http://www.asian-defence.com/2012/10/iaf-planning-to-phase-out-mig-27-combat.html.	
65.	Adequate Maintenance Schedule and Program	Ensure the AIP follows the applicable requirements, as appropriate (that is, USAF or NATO), concerning inspections. To enhance the safety of civilian MiG-23 operations, general maintenance/operations documentation should follow USAF or NATO maintenance program(s). The only modifications to the military AIP should be related to the removal of military equipment and weapons. Deletions should be properly documented and justified. A 100-hour, 12-month inspection program under appendix D to part 43 may not be adequate. Aircraft 23Y Description, Operating and Maintenance Instructions No. TK-245B is to be followed for MiG-23 operators. In these instructions there are 5 books: • *Book I – Airframe and Systems.* • *Book II – Aircraft Armament.* • *Book III – Radio and Radar Equipment.* • *Book IV – Aviation Equipment.* • *Book V – Ground Maintenance Equipment and Tools.* Each of these books contains information on the construction of the appropriate assemblies and systems, their principles of operation, standard equipment, and purpose. They also contain the sequence of performance of the scheduled maintenance operations prescribed in Inspection and Maintenance Guide No. 23Y (Variant "E"). Variant "E" is published as a separate book, deals with the description of the kinds of the aircraft preparation for flight, and contains lists of scheduled maintenance operations to be performed on the aircraft. The MiG-23 was designed for a three-tier maintenance concept/structure: squadron tier, regimental tier at the base level, and the third tier at the depot (information from the USAF HAVE PAD Final Report).	

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66.	Airframe, Engine, and Component Replacement Intervals (General)	Verify compliance with required replacement intervals as outlined in appropriate and most current military inspection guidance, as well as compliance with approved life limits and fatigue-life requirements, and track accordingly. Ask the applicant/operator for source data validating that guidance. Verify whether the AIP addresses the aircraft's airframe limits (calendar and total hours), how total time is kept, and the status of any extension. Engine TBO is also a requirement. Also verify compliance to Aircraft 23Y (MiG-13) Description, Operating and Maintenance Instructions No. TK-245B. If components are not replaced per the military guidance, ask for data to justify extensions. Applicants should establish and record time-in-service for all life-limited components and verify compliance with approved life limits. Set time limits for overrun of intervals and track cycles. Evaluate any overruns of inspection or maintenance intervals. See *Airframe Limitations and Durability (General)* below. Examples include, but limited to: • Fuel pumps; • Hydraulic pumps; • Pressure tanks; • Booster; • Bladder fuel tanks; • Generators; • Pyrotechnics; • Valves; • Actuators.	
67.	Airframe Limitations and Durability (General)	Verify the appropriate data is available to consider an extension past the life limit for the airframe and wings. Properly identifying the relevant and basic characteristics of the airframe and the engine will be useful in addressing the safety issues with the aircraft. See *Approved Airframe Extensions* below.	
68.	Depot Level Maintenance	Verify the AIP includes the proper records and references to any depot-level overhaul (common reference in former Soviet aircraft) and maintenance conducted before importation. These records must be translated into English.	
69.	Indian Air Force (IAF) MiG-23/MiG-27 Overhaul	If there are problems with overhaul requirements with a MiG-23 that was originally imported from a former Soviet Block country, consideration could be given to use the applicable guidance in English from the Indian Air Force. For example, the IAF's 11 Base Repair Depot, located on the outskirts of the bustling Maharashtra town of Nashik, has assumed responsibility for the overhaul of that air force's MiG-27 fleet (MiG-23s have been retired).	
70.	Required Inspections	Verify that the AIP includes the required inspections for the MiG-23. These include: • Daily inspection; • 50-Hour inspection; • 100-Hour inspection; • 400-hours scheduled servicing; • Annual (12 months) inspection;	
71.	1,500 Hour (or 17 Years) Airframe Limit	The MiG-23 is an aircraft that was designed with fatigue life limits as part of the process. The airframe had a fatigue life of 17 years or 1,500 hours, whichever came first. The "life" remaining in an airframe is in fact a deciding point in the MiG-23 aircraft acquisition. For example, when the MiG-23 was acquired from Bulgaria, the issue is to adequately determine the remaining "utility life" in the airframe. Additionally, various differences exist between aircraft. Although there are "after market" airframe life-limit extensions, possibly up to 3,000 hours, adequate documentation to this effect is required. A simple claim that the aircraft has been "overhauled" or "certified" past the 1,500-hour limit is not sufficient. This is a real issue that has not been properly addressed as shown by the January 2013 advertising for a MiG-23 with an airworthiness certificate, FAA-approved inspection program, and yet it is listed as having 1,500 hours. In addition, this 1981 MiG-23 certainly exceeds the 17-year limit as well. See http://www.controller.com/listingsdetail/aircraft-for-sale/MIKOYAN-MIG-23/1981-MIKOYAN-MIG-23/1251517.htm. See *IAF Airframe Life-Limit Process* for additional details on the practical applicability of the aircraft life-limit. Note: Some have assumed, incorrectly, that because the aircraft is a former Soviet aircraft, "it was built like a tank" and will "last forever." In many cases, this has been translated into meaning that anything goes, especially in terms of minimum maintenance. This is incorrect. Granted, Soviet aircraft, like them MiG-23, have certain characteristics that lend themselves to practical applications in a frontline environment, but the fact remains that they are complex machines, which require structured oversight. As combat aircraft, the MiG-23 and the MiG-27 may have good design and may have been ahead of their time when they were inducted, but poor workmanship and poor quality of metallurgy in the Soviet era resulted in aircraft with very little life span. It is often said that Soviet built jets came at throw away price to export customers because they had short spans.	

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72.	IAF Airframe Life-Limit Process	The following is provided to explain the application of the aircraft airframe life-limit. In the IAF, the "MiG-23BN was initially assigned the Total Technical Life (TTL) of 1,500 hours and Calendar Life (CL) of 15 years, with an interim overhaul at 800 hours. After another 800 hours and the Medium Repair, the TTL/CL was further extended to 2,250 hours/25 years and, later, to 30 years after the Capital Repair carried out at 1,800 hours/25 years." Gokhale, 2009.	
73.	Misrepresentations of MiG-23 Overhaul and Condition	Caution is advices in accepting claims that the aircraft is "overhauled" or "zero-timed." It is important to note that many operators misrepresent the true condition of the aircraft. Some advertise their MiG-23 as low time airframes, when in reality the opposite is true. For example, the seller of a MiG-23 advertised his aircraft as having "only 1,403 hours since new…and only 157 hours since complete overhaul both airframe & engine…" This seriously misrepresents the aircraft's true condition and airworthiness in many respects. For one, 1,403 hours is high, not low. It is very close to the 1,500 limit. In addition, representing the assembly and minimal restoration done to the aircraft as a "complete overhaul" is also inaccurate because that is a task (technically referred to as a factory refurbishment [Depot Level in the US] an overhauled is discussed below) is performed by the manufacturer or a delegated facility, common in the Soviet days, and provided today by only some facilities, such as some in Belorussia and Ukraine, typically costing about $1 million. It is not a task that an FBO can accomplish in the US without manufacturer's support. Finally, representing the engine as having 157 hours is also misleading because it is not low time compared to the engine's TBO (possibly under 200 hours) and the fact that it ignores calendar time, that is, that an engine overhaul done in the Czech republic in 1993 is not truly representative of the engine's condition in 2013.	
74.	Main Overhaul at 750 Hours or 7/8 Years	Ensure that the AIP follows the requirement that MiG-23 is required a main overhaul after 7 or 8 years, or 750 hours, whichever came first.	
75.	Approved Airframe Extensions	If operations beyond the 1,500 airframe life-limit of beyond the 750-hour maim overhaul, there must be manufacturer-approved data and processes. MiG-23 extensions are not de facto accepted because an operator did a "homemade" overhaul or zero-timed the aircraft." For example, MiG-23s are being targeted by Russian Aircraft Corporation MiG (RSK MiG) for its rolling airframe life extension; initially, this would give a life of 20 years or 2,000 hours. Eventually, service life extensions to 30 years or 3,000 hours may be an option, depending on the airframe's condition in terms of fatigue and corrosion, which is particularly important for the wing pivots, known to be the most sensitive parts of the MiG-23's airframe. This means with the relatively inexpensive airframe/systems service life extensions now being offered by the RSK MiG, these exports manufactured in the early 1980s could carry on for 25 years, assuming reliable logistic support was provided. However, "homemade" versions of these options are not acceptable without the approved data, and processes. See *MiG (Manufacturer) MiG-23 Life-Extension Bulletins* below.	
76.	MiG (Manufacturer) MiG-23 Life-Extension Bulletins	If any extension to a life-limit is proposed, verify that the appropriate manufacturer Life Extension Bulletins are available and followed.	
77.	Missing Inspection Tasks	Verify the AIP follows the applicable requirements (i.e., NATO) in terms of inspection tasks. It is imperative that no inspection tasks required by the military standard are removed, unless they are weapon system related. If any non-weapons system tasks are removed, there should be adequate justification, and it cannot be solely cost-related. There have been several cases where an AIP did not conform to the applicable military standard and tasks were removed without adequate justification, not because they are not needed, but because the operator cannot or does not want to pay for it.	
78.	Drag Chute	Verify the drag chute and system(s) are inspected per the applicable guidance and the AIP reflects that installation. Verify the AIP incorporates proper maintenance, component replacements(s), and packing of the drag chute. The system does fail. For example, on December 28, 2011, "while a MiG-23 aircraft was on take off roll (seven markers to go); an Indian Air Force Runway Controller observed that the tail chute of the aircraft got operated. He immediately transmitted the same on R/T. The prompt call was monitored by the Pilot, SFS and ATC and the takeoff was aborted." http://indianairforce.nic.in/fsmagazines/SEP%2012.pdf. In all cases, there should be adequate technical data to validate the installation and by trained personnel. The MiG-23 incorporates a single, cross-shaped 21-meter drag chute to supplement the wheel brakes and increase safety by reducing the landing roll. The drag chute is pneumatically actuated by manual control after touchdown and jettisoned manually by electrically actuated controls. The drag chute canopy, shroud lines, and release cables are stowed in a compartment located on the vertical stabilizer. The drag chute cables are attached to the aft spar of the vertical stabilizer. Note: There were incidents where the aircraft's chute failed to deploy properly (refer to attachment 5). Therefore, use of the drag chute (the mod is available and many were so modified) in MiG-23 operations is a basic safety requirement.	
79.	Appendix G to 14 CFR Part 23	Recommend appendix G to part 23 be used as a tool (not a requirement) because it can assist in the review of the applicant's proposed AIP and associated procedures and sets a good baseline for any review. Appendix G to part 23 covers instructions for continued airworthiness.	
80.	Prioritize Maintenance Actions	Recommend the adoption of a risk management system that reprioritizes high-risk maintenance actions in terms of (a) immediate action, (b) urgent action, and (c) routine action. Also refer to *Recordkeeping, Tracking Discrepancies, and Corrective Action,* below.	

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81.	Cannibalization	Cannibalization is a common practice for several former military aircraft operators and service providers. It is common in former military aircraft, especially imported ones where OEM support is non-existent and parts difficult to acquire. The extent to which it takes place is not necessarily an issue, but keeping adequate records of the transfers, uses, and condition is. In 2001, the U.S. Government Accountability Office (GAO) published its findings on cannibalization of aircraft by the U.S. Department of Defense (DOD). It found cannibalizations have several adverse impacts. They increase maintenance costs by increasing workloads and create unnecessary mechanical problems for maintenance personnel. The GAO also found that with the exception of the Navy, the services do not consistently track the specific reasons for cannibalizations. In addition, a U.S. Navy study found cannibalizations are sometimes done because mechanics are not trained well enough to diagnose problems or because testing equipment is either not available or not working. Because some view cannibalization as a symptom of spare parts shortages, it is not closely analyzed, in that other possible causes or concerted efforts to measure the full extent of the practice are not made.	
82.	Safety Implications of Spare Parts Shortage	It is essential to considered spare parts availability part of the AIP and the operation and maintenance of the aircraft as a whole. Current MiG-23 operators continue to suffer from a severe shortage of spare parts for the aircraft. It is not just a funding issue, but also OEM support. In civil use, this had been a serious issue ever since the first MiG-23 came into in the US. In fact, "Warbird" groups and forums constantly make reference to the lack of spare parts. A current MiG-23 restorer's Web log focus on this very issue. This in turn leads to serious safety shortcoming, including the likelihood not to replace a time limited item, and use unapproved parts with undocumented origin. In addition, some parts are fabricated, but there is no evidence of conformity or basic DER data to the originals specifications. All combined, these present a serious drawback to ensuring the airworthiness of the aircraft. See *Parts Fabrication* below.	
83.	Parts Fabrication	Verify engineering (that is, designated engineering representative) data supports any part fabrication by maintenance personnel. Unfortunately, many modifications are made without adequate technical and validation data. AC 43.18, Fabrication of Aircraft Parts by Maintenance Personnel, may be used as guidance.	
84.	Recordkeeping, Tracking Discrepancies, and Corrective Action	Check applicant recordkeeping. The scope and content of §§ 43.9, 43.11, and 91.417 are acceptable. Recommend the use the USAF Form 781 process (or NAVAIR MAF, or RAF Form 700) to help verify an acceptable level of continued operational safety (COS) for the aircraft. Three types of maintenance discrepancies can be found inside USAF Form 781: (1) an informational, that is, a general remark about a problem that does not require mitigation; (2) a red slash for a potentially serious problem; and (3) a red "X" highlighting a safety of flight issue that could result in an unsuccessful flight and/or loss of aircraft—no one should fly the aircraft until the issue is fixed. For more information on recordkeeping, refer to AC 43-9, Maintenance Records.	
85.	Qualifications of Maintenance Personnel	Check for appropriate qualifications, licensing, and type-specific training of personnel engaged in managing, supervising, and performing aircraft maintenance functions and tasks. The NTSB has found the use of non-certificated mechanics with this type of aircraft has been a contributing factor to accidents. Only FAA-certificated repair stations and FAA-certificated mechanics with appropriate ratings as authorized by § 43.3 perform maintenance on this aircraft.	
86.	Ground Support, Servicing, and Maintenance Personnel Recurrent Training	Recommend regular refresher training is provided to ground support, servicing, and maintenance personnel concerning the main safety issues surrounding servicing and flight line maintenance of the aircraft. Such a process should include a recurrent and regular review of the warnings, cautions, and notes (or Soviet equivalent) listed in the appropriate technical manuals. Note: Ejection seat safety is paramount.	
87.	Parts Storage and Management and Traceability	Recommend establishing a parts storage program that includes traceability of parts. This is important in many cases because there is no original equipment manufacturer (OEM) support. That will be the case with the MiG-23. This level of documentation is essential to safe MiG-23 operations, especially in light of the fact of the quality, condition, and sources of MiG-23 parts and components from outside the United States. In fact, in 1999, the 28th Fighter Regiment of the Polish Air Force (operating MiG-23s) was dissolved and a lack of spare parts for the MiG-21 further decreased the number of serviceable aircraft available for the Polish Air Defense System.	
88.	Appropriate Nomenclature	Verify that the AIP provides for the appropriate nomenclature used in the MiG-23. This is necessary to avoid confusion, especially when US trained personnel are involved with unfamiliar terminology, designations, units, and components.	
89.	Maintenance Records and Use of Tech Data	Conduct a detailed inspection of maintenance records, as required by FAA Order 8130.2. Verify maintenance records reflect inspections, overhauls, repairs, time-in-service on articles, and engines. Ensure all records are current, in English, and appropriate technical data is referenced. This should not be a cursory review. Maintenance records are commonly inadequate or incomplete for imported aircraft. In many cases involving MiG-23 aircraft, adequate records are essentially because of the high likelihood that the aircraft and many of its components may have reached their life-limit. Many have absolutely no records describing its past military history. If the history of a life-limited component cannot be documented, it must be assumed to have reached its time/cycle limit.	
90.	Aircraft Re-Assembly Issues	In many cases operators have re-assembled aircraft, "cleaning," "checking," and "servicing" components as part of that process. It cannot be assumed that such work is equivalent to an overhaul or the equivalent of a Soviet Deport level refurbishment. As a result, all work accomplished for the re-assembly of the aircraft must be properly tagged or classified as such if it differs from required inspections per the applicable guidance. This is particularly important because some operators may classify, on their records, work on components as "on condition" or "zero-timed" and use that classification to later defer required inspections. That is not acceptable. Refer to *"On Condition" Inspections* above.	

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91.	Soviet Aircraft Maintenance Philosophy	The MiG-23, along with its powerplant (i.e., R-29) had a very short service life, but in operational military use (combat ready), this was not an issue since the type was expected to remain with an operational unit for only a limited number of hours before a major, depot-level overhaul was required. This was common Soviet philosophy. Operational units were not expected to worry about repairing their aircraft, engines, equipment, and armament beyond the most elementary maintenance. Instead, they were to operate them through their relatively short allotted operational lifetime and then exchange them for reserve or newly overhauled aircraft or/and engine. The implication for civil use is not, as some have argued, that Soviet life-limits do not apply, but rather that safe operation must include tight compliance to not only the limitations themselves, but also the associated level of repair and overhaul, and guidance. There is no technical data (or operational data from MiG-23 past or current military operators) to suggest that an R-29 engine for example, with its very short life-limit, can be safely operated for 700 before an overhaul. That overhaul, which under Soviet guidance is a MO or Major overhaul, is not a "homemade" in the "back of the hangar" process with "manuals that have not be translated into English," but a depot-level activity with adequate technical support. There is no other technical guidance to be used to assume the level of safety the aircraft had in frontline service and even more to assume a level of safety acceptable in civil use.	
92.	Aging	Verify the AIP addresses the age of the aircraft per the applicable technical guidance. This means many, if not all, of the age effects have an impact on the aircraft, including: (1) dynamic component wear out, (2) structural degradation/corrosion, (3) propulsion system aging, (4) outdated electronics, and (5) expired wiring.	
93.	Use of Cycles (General)	Recommend the AIP provides for tracking cycles, such as airframe and engine cycles, in addition to time and in combination with inspections. This allows for the buildup of safety margins and reliability. In military jet aircraft, there is a relationship between parts failures, especially as they relate to power plants, landing gear, and other systems, and for that reason it is very important to track airframe and engine cycles between failures and total cycles to enhance safety margins. For example, tracking all aircraft takeoffs for full-thrust and de-rated thrust takeoffs as part of the inspection and maintenance program would be a good practice and can assist in building up reliability data. The occurrence of failures can be readily reduced to meaningful statistics, and cycles can play an important role. When rates are used in the analysis, graphic charts (or equivalent displays) can show areas in need of corrective action. Conversely, statistical analysis of inspection findings or other abnormalities related to aircraft/engine check and inspection periods requires judgmental analysis. Therefore, programs encompassing aircraft/engine check or inspection intervals might consider numerical indicators, but sampling inspection and discrepancy analysis would be of more benefit. A data collection system should include a specific flow of information, identity of data sources, and procedures for transmission of data, including use of forms and computer runs. Responsibilities within the operator's organization should be established for each step of data development and processing. Typical sources of performance information are as follows, however, it is not implied that all of these sources need be included in the program nor does this listing prohibit the use of other sources of information: • Pilot reports, • In-flight engine performance data, • Mechanical interruptions/delays, • Engine shutdowns, • Unscheduled removals, • Confirmed failures, • Functional checks, • Bench checks, • Shop findings, • Sampling inspections, • Inspection discrepancies, and • Service difficulty reports.	

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94.	Correct Wing and Related Issues	Ensure the AIP requires the MiG-23 in question to be equipped with the proper wing, and that all related issues are also addressed. The issue to prevent the use of the incorrect wing for the version or variant being certificated. As background, the “No. 2 wing” (Type 2 Wing) was introduced on the MiG-23M. This featured a new extended leading edge that gave a dramatic leading-edge “dogtooth” or “claw.” The aim of this modification was to increase wing area by increasing chord along the whole span. Leading edge slats were deleted from the No. 2 wing, and then re-introduced on the otherwise identical No. 3 wing, which was phased in during 1973. At the same time the No. 2 wing was introduced, the MiG-23’s horizontal tail surfaces were moved aft, leaving a larger gap between wing trailing edge and tail plane leading edge. This increased control authority and reduced stability, making the new aircraft slightly more agile in pitch. It also made the rear fuselage look totally different, because at the same time the jet pipe was made shorter. The original wing, however, without claws, seems to have been fitted to the 2 UB prototypes. This may indicate that the MiG-23UB prototype marked and interim step between the MiG-23S and the MiG-23M, with the latter aircraft being phased out on the airframe and engine improvements of the two-seater, coupled with the full-up weapons system and radar. Production two-seaters all had the No. 3 wing, allowing the aircraft to carry 3 external fuel tanks.	
95.	Swing-Wing System	The AIP must address, in great detail, the inspection, and maintenance of all of the swing-wing systems and mechanism as per the appropriate guidance. This system is critical, and failures can be catastrophic. For example, two Western analysts, detailed to a Soviet Air Force MiG-23 base in 1975 noted: “The airfield at which we trained on MiG-21s was also the base for MiG-23 training. During our time there two of these aircraft were lost when the manually controlled wing-sweep system failed and the wings remained swept. One pilot ejected, the other was killed.” http://www.flightglobal.com/pdfarchive/view/1975/1975%20-%201968.html.	
96.	IAF MiG-27ML Structural Upgrades	If applicable, recommend that applicant document any benefit of the structural upgrades made by the Indian Air Force to the MiG-27ML. As part of the upgrade, the modified aircraft were also subjected to structural upgrades. These may alleviate some of the structural issues with the aircraft. Hindustan Aeronautics Limited’s (HAL) Nasik Division is the primary contractor. To this end HAL is expanded the Design Department at the Nasik Division into a full-fledged Bureau, re-designated as the Aircraft Upgrade Research and Design Centre (AURDC), in 1996. AURDC is heavily involved in the re-design and structural modifications of the aircraft as part of the upgrade. The Nasik Division has undertaken structural integrity studies to extend the life of MiG variants, including the MiG-23 series aircraft. See http://hal-india.com/AircraftNasik/Services.asp.	
97.	MiG-23 Maintainers Differences Training	Recommend the applicant/operator provide (in the AIP or SOPs) for differences training between MiG-23 models for all maintainers. Significant differences include engine, instrumentation, drag chute, CG variations, and ejection seat.	
98.	Periscope (MiG-23UB)	Ensure the AIP addresses the required inceptions and functionality of the periscope fitted to the MiG-23 two-seaters. Note: The rear cockpit was fitted with a retractable periscope to give the instructor a better view over the nose and the head of his pupil during takeoff and landing.	
99.	Air Intakes and Ducts	Verify the AIP incorporates the inspection of the two air intakes, splitter plates, horizontal guide vanes, and ducts, as per the applicable technical guidance, and as part of pre-flight.	
100.	Air Brakes	Verify proper condition, deflection, cylinder condition, and warning signage of the air brakes. The dangers the air brake poses to ground personnel are lethal and should also be addressed.	
101.	Pitot Tubes	Verify that the AIP and related procedures, including pre-flight, cover the inspection and maintenance of the aux. and main air pressure “receivers” (pitot tubes).	
102.	No. 2 Fuel Tank	Ensure the AIP addresses the proper inspection and modifications to the No. 2 fuel tank. After a structural failure and a non-fatal crash on March 14, 1972, it was found that the wing pivots and the No. 2 fuel tank (which forms the basic structure of the center fuselage) tended to crack, and had failed at only 7 Gs. To solve this problem, new metallurgical processes were introduced (bubbles of hydrogen in the metal), along with better quality control measures, and local strengthening plates were added to existing aircraft.	
103.	Wing Root Refueling Valves (Fuel Ports)	The AIP and related servicing need to emphasize the refueling valves and related procedures. This is necessary because there are significant differences between variants of the aircraft in terms of refueling. This can lead to refueling errors. For example, an expert in Soviet aviation noted that “many MiG-23 of various operators were not the same. This led to difficulties and misunderstandings when planes were exchanged or during multi-national Warsaw Pact exercises. A good example was the fuel ports. The MiG-23MFs had some valves in the wing-roots which could be closed so that the wing tanks would not receive fuel, thus making the aircraft lighter and more maneuverable, at the expense of fuel quantity. These valves allowed for stopping refilling the wing fuel tanks, when shorter training or other specific flights were conducted. Usually, export-Floggers had one central filling-orifice as well as two other filling ports leading to fuselage/wings fuel tanks directly. For comparison, Soviet MiG-23s lacked that central filling port and wing fuel tanks had to be filled manually. These lacked those wing fuel valves mentioned above. I am not sure but it is believed that some Czech MiG-23MLs lacked the central filling port as well, while definitely some of the MiG-23MFs delivered to Romania in 1982 lacked the wing-valves. As for the ex-Bulgarian Air Force MiG-23s, I don’t, but there is enough room for refueling errors...” Georg Mader. Note: Romanian MiG-23MFs had no provision for the closure of the fuel supply line to the wing tanks within the aircraft’s fuel system.	

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104.	Fuel System “O“ Rings	Verify that the AIP addresses the inspection and replacement (with the correct hardware) of the fuel system “O” rings. In fact, a MiG-23 restorer noted that “we put 25 liters of fuel into the single-point connection and got 20 liters on the floor. With some fixing, we put 125 liters in and got only 0.5 liters to leak out. Hopefully with some new O-rings the leak will be completely fixed.” http://blog.cwam.org/search?updated-max=2010-11-11T00:00:00-06:00&max-results=4&start=40&by-date=false.	
105.	Inspect and Repair as Necessary (IRAN)	If an IRAN-like process is proposed (or Soviet equivalent, which is unlikely), verify it is detailed and uses adequate technical data (that is, include references to acceptable technical data) and adequate sequence for its completion if it is proposed. An IRAN must have a basis and acceptable standards. It is not analogous to an “on condition” inspection. It must have an established level of reliability and life extension. An IRAN is not a homemade inspection program.	
106.	Combining Inspection Intervals Into One	Set time limits for overrun (flex) of inspection intervals in accordance with the applicable technical guidance.	
107.	Aircraft Storage and Returning the Aircraft to Service After Inactivity	Verify the applicant has a program to address aircraft inactivity (more than 7 days) and specifies specific maintenance actions for return to service per the applicable inspection schedule(s) (for example, after 31 days). <u>A daily inspection or “preflight” is not an acceptable equivalent to a detailed inspection to return the aircraft to flight after 30+ days of inactivity.</u> The aircraft should be housed in a hangar during maintenance. When the aircraft is parked in the open, it must be protected from the elements, that is, full blanking kit and periodic anti-deterioration checks are to be carried out as weather dictates.	
108.	Specialized Tooling for Maintenance (General)	Verify adequate tooling, jigs, and instrumentation is used for the required periodic inspections and maintenance per the maintenance manuals. This is important because the MiG-23 is a “metric” aircraft and requires appropriate instrumentation, tools, and related equipment in metric units. Also, a MiG-23 assembly requires specialized equipment such as wing dollies, tail dollies, and engine dollies.	
109.	Tail and Engine Dollies	Verify that the AIP provides both the tail and engine dollies and that they are available. They are not necessarily interchangeable. This is an issue of concern because the MiG-23’s was known for its weak aft structure, prone to failure, and could lead to engine fires in addition to structural damage. In addition, a MiG-23 restorer stated that “with some clever modification a MiG-23 engine dolly can be made to work as a MiG-23 tail dolly. We were able to pull the tail back to expose inner connections of the single-point fuel port.” http://blog.cwam.org. These practices can be risky and need to be addressed.	
110.	Engine Removal and Installation	The AIP needs to ensure that all of the applicable equipment and procedures concerning the removal and installation of the R-27 or R-29 engine is followed precisely. The airframe engine tolerances in the MiG-23 are very small, and it is easily damaged. This damage can be catastrophic for the structure and for the engine. It is imperative the appropriate equipment and procedures be used. A MiG-23 restorer’s crude approach to this task illustrates this concern: “How do you lift a 5,000 pound Tumansky R-27F2-300 turbojet engine into its stand (when you're not really sure what you're doing)? *Very* carefully! We lifted one end with the A-frame hoist borrowed from the CAF and the other end with the forklift. It came up out of its shipping stand just an inch at a time. We kept the camera rolling... if we dropped it; we *definitely* wanted that on video! The "conservation" oil that was placed in the engine before shipping is amazingly slippery on the hangar floor. Cleanup is a must! Once on the stand the engine can easily be moved around. Adjustments allow each corner of the engine to be lifted slightly differently and a winch precisely controls the movement of the engine when it's put into the back of the MiG-23.” http://blog.cwam.org/2009/01/mig-23-engine-stand.html.	
111.	Stuck Throttle	Verify that the AIP and related SOPs (i.e., FCF) include the throttle inspection. Stuck throttles have caused several MiG-23 accidents.	
112.	Technical Guidance and Changes Issued While in Service	Verify the AIP references and addresses the applicable technical guidance issued to the aircraft during military service to address airworthiness and safety issues, maintenance, modifications, updates to service instructions, and operations of the aircraft. For example, if the aircraft is an Ex-Bulgarian Air Force MiG-23, the technical guidance available needs to reflect the fact that the aircraft as retired in 2002 and thus the latest data available at that time must be used.	
113.	Safety Supplements	Verify the applicant/operator has copies of the applicable safety supplements (or Soviet equivalent) for the aircraft and they are incorporated into the AIP or operational guidance as appropriate.	
114.	Corrosion Due to Age, Inadequate Storage, and Materials Used	Ask whether a corrosion control program is in place. If not, ask for steps taken or how it is addressed in the AIP. Evaluate adequacy of corrosion control procedures. Age, condition, and types of materials used in many former military aircraft require some form of corrosion inspection control. This is paramount in the MiG-23 not only because of its age, but because of many of the materials used in the aircraft. See for *Corrosion Control Guidance* below adequate references.	
115.	Corrosion Control Guidance	Verify that the AIP incorporates the adequate corrosion control guidance. It includes: • Refer to FAA 8083-30, Chapter 6; • FAA Advisory Circular (AC) 43-4A, Corrosion Control for Aircraft; • TO 1-1-691, Corrosion Prevention and Control Manual.	

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116.	Pylons (Structural)	If applicable and installed, verify the AIP addresses the inspection of the aircraft's pylons per the applicable guidance from a structural standpoint, including checking them for cracks. Note: The MiG-23MF had a total of seven pylons; two on the mobile wing section (these were only used for PTB-800 auxiliary fuel tanks and were to be used only with the wing at the maximum sweep angle of 16°); two on the wing gloves (inboard), two in the fuselage under behind the air intakes, and one on the centerline under the fuselage, for auxiliary fuel tanks only.	
117.	Engine Maintenance Procedures	Verify the AIP adheres to the maintenance procedures requirements per the applicable engine guidance. This includes having the complete set of applicable manuals for the specific version and variant of the engine.	
118.	R-27 or R-29 Versions and Variants	Ensure the AIP not only addresses engine type, but versions and variants. This is important in many aspects of the maintenance and operations of the aircraft, especially in light of the fact that many entities (countries and "repair plants") were involved in the maintenance and supply aspect of engine maintenance and support. Parts traceability is another reason to adhere to such detailed practices. Note: For example, the MiG-23UB has the R-27F-2M-300, while the MiG-23MF will have the R-29-300 engine.	
119.	Engine Modifications	Verify the AIP addresses the incorporation of the manufacturer and military modifications to the engine installed. The NTSB and some foreign CAAs have determined a causal factor in some accidents is the failure of some civil operators of former military aircraft to incorporate the manufacturer's recommended modifications to prevent engine failures.	
120.	Cycles and Adjustment Engine Replacement Intervals	Ask if both engine cycles and hours are tracked. If not, recommend it be done.	
121.	R-27/R-29 Failures and Failure Modes	Verify the AIP discusses the known engine failure and failure modes such as compressor and turbine casing failures. A critical one in IAF service was related to the low-pressure turbine blades of the R-29. This was found following several accidents and a grounding of the Indian Air Force fleet in 2010. A former East German AF pilot recalls his close call on the MiG-23: "I performed a start followed by higher aerobatics in the aerobatic zone above the airfield. Flight time was regularly about 20 minutes to landing, there was often flown with maximum power. This flight went normally until just before landing. At approximately 1 km before the beacon (OM), suddenly the engine overheat light went on. At this point I had no other option than to continue the landing. As I recall, I either turn the engine off after the landing or the hydraulic nose wheel steering failed, in any case, I [had a hydraulic failure, leaking]. Turns out that a crack had appeared in the combustion chamber and the escaping hot gases hit hydraulic lines, and (also worse) damaged a bulkhead. The thermal overload could not be repaired and eventually the machine was not used again." http://home.snafu.de/veith/verluste9.htm.The following account of a Soviet MiG-23 accident illustrates one of the engine failure modes in the MiG-23: "On September 21, 1978 a senior pilot, pilot 2nd class, Lieutenant G. Sidorenko [was flying № 118]. After take-off…at 400 meters before turning off the afterburner, the pilot heard a thud in the engine compartment and saw the fire light "Engine overheating"[came on]. This was reported to the flight director. At the command of the head of the flight, the pilot turned off the afterburner, reduced the engine speed to 70%. Engine temperature dropped from 900 degrees to 500 degrees Celsius, and the lamp "Engine overheating" faded. Later, during the third turn for landing at an altitude of 600 meters, the "engine overheating" light came back on. At this point, the pilot saw the fire from the right side of the fuselage in front of the keel and the ring of flame around the fuselage and around the tail. He climbed…the pilot discovered that he had lost control, and was ejected at an altitude of 400 meters and a speed of 550 km/h. Reason: The in-flight fire arose from a fatigue in the rotor blade number 71 of the first stage turbine. The emergence and development of the fatigue crack was on the inside surface of the front edge of the blade at a distance of 41 mm from the base of the castle because of its lack of 'strength' [manufacturing]." http://scucin-avia.narod.ru/catastrofy/katastrofa_Mig-23ml-1978.htm. Note: The Tumansky R-29 is a Soviet aircraft turbojet engine that was developed in the early 1970s. It is generally described as being in the "third generation" of Soviet gas turbine engines which are characterized by high thrust-to-weight ratios and the use of turbine air cooling.	
122.	Engine Components Life Limits	Verify the AIP addresses the life limit of engine components. "On condition" inspections are not acceptable for any engine components. Refer to *Engine Inspections and Time Between Overhaul (TBO) or Soviet Equivalent* below.	
123.	Engine Inspections and Time Between Overhaul (TBO) or Soviet Equivalent	Verify the applicant has established the proper inspection intervals and TBO/replacement interval (or Soviet equivalent) for the specific engine type and adhere to those limitations and replacement intervals for related components. No deviations. This applies to the engine, whether a Tumansky R-27 (rated 5,200 kg, or 7,800 kg with afterburner) or later model MiG-23 aircraft used the Tumansky OKB R-29-300 (8,300 kg, with 12,500 kg with afterburning). Justification and FAA concurrence is required for an inspection and TBO above those set in the appropriate aircraft/engine inspection guidance. Clear data on TBO/time remaining on the engine at time of certification is critical, as is documenting those throughout the aircraft life cycle. According to the Project HAVE PAD Final Report, dated September 1, 1978, "the engine operated during the flight test program for approximately 87 hours with no major propulsion problems or pilot complaints." It is imperative that engine inspection and maintenance be conducted. The principal deficiency contributing to the relatively short time between overhaul (150-200 hours) appears to be inadequate consideration of low-cycle fatigue in the engine design and development.	

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124.	R-27 or R-29-300 Maintenance Procedures	The MiG-23, like other Soviet-era built aircraft, is prone to engine failures, regardless of engine type. Ensure maintenance is conducted, at a minimum, per the applicable Aircraft 23Y Description, Operating, and Maintenance Instructions No. TK-245b, Book 1, Airframe and Systems Part II (Power-plant, Engine Control System, Air Intake Ramp Control System, Fuel System, Fire-Extinguishing Equipment).	
125.	R-35 Engine	Verify whether the aircraft is equipped with the Khatchaturov R-35-300 engine instead of the R-27 or R-29B-300. If so, the AIP and all associated procedures must reflect this. For example, the R-35 was installed in the MiG-23MLD Flogger-K.	
126.	Lyulka AL-21 Turbojet	Ask whether the aircraft is equipped with the AL-21 engine instead of the R-27 or R-290. If so, the AIP and all associated procedures must reflect this. For example, the MiG-23Bs were powered by the Lyulka AL-21 turbojet with a maximum thrust of 11,500 kg. The production of this variant was limited, however, but it possible that such as aircraft may be obtained. The AL-21 was known for its lack of reliability and was considered the 'Achilles point" of the MiG-23B in which it was installed.	
127.	AL-31F-30S Engine Upgrade	Verify whether the aircraft is equipped with the AL-31F-30S turbofan upgrade instead of the R-29B-300. If so, the AIP and all associated procedures must reflect this. This is not a "homemade" upgrade, but one provided by the manufacturer and made available (at least for the MiG-27) in 2008.	
128.	Air Conditioning Oil Contamination	Verify the AIP addresses the inspection and replacement of all critical oil system components that can lead to oil leaks into the air conditioning system and accidentally delivered to the pilot or crew (cross-contamination). The oil used may have toxic characteristics.	
129.	Engine Check	Verify the AIP includes adequate procedures (per the applicable technical guidance) including checks and signoffs for returning an aircraft to airworthiness condition after any work on the engine. As an example, as part of its investigation of a fatal former military aircraft accident in 2004, the NTSB found after an engine swap-out the week before the fatal accident, the mechanics had warned the newly installed engine was not operating correctly. The record also shows the A&P mechanic who oversaw and supervised the engine change did not sign off any maintenance records to return the airplane to an airworthy status. Before the fatal flight, two engine acceleration tests failed, and multiple aborted takeoffs took place in the days leading up to the crash.	
130.	Engine Thrust	Verify the AIP includes measuring actual thrust of the engine and tracking engine operating temperatures. The R-29-300 represents a significant performance improvement over previously exploited Tumansky power plants, including the R-11, R-13, and R-25. The hardware was manufactured in 1974 and designed in 1965. The R-29-300 is an improvement over the R-13 and follows proven and well established Tumansky Design Bureau practice. Performance improvements have been made in the area of airflow handling capacity, turbine inlet temperature turbine cooling philosophy, combustor design, acceleration characteristics, and engine control logic. Airflow handling capacity of the R-29 is 38.8 lb./sec/ft^2, while R-11 and R-13 engines were 36.6 and 37.7 lb./sec/ft^2 respectively. The higher this airflow handling parameter, the lower the compressor diameter for a given airflow, which in turn reduces basic engine diameter. The maximum turbine engine inlet temperature for the R-29-300 is estimated to be 1533 degrees Kelvin. The value is approximately 110 degrees greater than that of any known Soviet powerplant. Specific thrust for the R-29 is 114 lb./lb./sec, while the R-11's specific thrust is 88.4 lb./lb./sec and R-13 is 95.5 lb./lb./sec.	
131.	Afterburners and Nozzle	If applicable, verify the AIP specifically addresses the inspection of the afterburner system and the augmenter nozzle and related actuators. Afterburner failures were common. The following account by an IAF mechanic illustrates one of the failure modes of this system: "On Feb 21, 2012, a [mechanic] was detailed to carry out LFS on a MiG-27 ML aircraft. During the checks, he noticed a circumferential hair line crack around the seam welding of the 1st row 'After Burner Fuel Manifold' pipe line, connecting the 'After Burner Fuel Flow Divider' to 'AB manifold' inside the diffuser. This crack was detected visually by the air warrior, which was extremely difficult to be noticed due to its location and lack of natural lighting. If this crack had gone unnoticed, it could have led to a serious accident / incident during A/B engagement for takeoff." http://indianairforce.nic.in/fsmagazines/DEC%2012.pdf. Another afterburner incident noted that "on October 12, 2010, [the mechanic] was detailed to carry out FFS on a MIG-23 aircraft. During Dl, he observed a length wise welding crack at diffuser ring holding flange of the after burner at 8 o'clock position. The crack was at remote location and could have gone unnoticed. Had this gone unnoticed, it might have led to diffuser burst/ fire hazard resulting in disastrous consequences." http://indianairforce.nic.in/fsmagazines/May11.pdf. Two other incidents follow: "On January 11, 2011, Sgt. Kumar was detailed as Gang I/C for MIG-23 aircraft. While carrying out his supervisory checks he noticed a loose bolt near the telescopic ring of the jet nozzle in the exhaust area. The bolt was in a position where it could not be distinguished from the associated structure and could have been easily missed. Had this gone unnoticed, the bolt might have got stuck in the jet nozzle operating cylinders leading to a catastrophic accident." http://indianairforce.nic.in/fsmagazines/Sep11.pdf. On February 19, 2011, "Sgt. Biswas was detailed to carry out super structure ground run on a MiG-23 aircraft. During visual checks, a crack of 6-8" on jet nozzle outer casing was noticed at 6 o'clock position. If this crack had gone unnoticed, it could have led to an incident/accident." http://indianairforce.nic.in/fsmagazines/Oct11.pdf.	
132.	Use of Different Fuels and Fuel Quality	Verify the AIP addresses how the use of different fuels may require changes or additions to the R-27 or R-29 inspection and maintenance program. Note: The fuels used in the MiG-21's engines were T-1, TS-1, T-2, and T-7. Some of these may have a high Hydrogen content. Suitability of all Western fuel should be checked. The AIP should also address fuel quality.	
133.	External Fuel Tanks	The AIP needs to provide for the maintenance and inspection of the approved external fuel tanks as per the applicable technical guidance.	

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134.	Engine Ground Run	Verify the engine goes through a ground run and check for leaks after reassembly. Confirm it achieves the required revolutions per minute for a given exhaust gas temperature (EGT), outside air temperature, and field elevation. There should be documentation to show this was done per the applicable technical guidance.	
135.	Fire Detection and Suppression System	Verify the serviceability of the fire detection and suppression system. With the aircraft's history of engine fires, this is a critical system and must be operational per the applicable guidance. The operator should establish an inspection process (reference the appropriate technical guidance) to ensure the validity of the fire warning system. The MiG-23 has fire detection and extinguishing systems consisting of a high-pressure container, special extinguishing fluid, control relay, electronic amplifier, distributing ring, squib valve, and sensor ring. Some even have an inert gas system in the fuel tanks to prevent fire.	
136.	Servicing, Engine Fire Servicing Personnel Unfamiliar With the Aircraft Create Hazardous Situations	Ensure the operator warns servicing personnel via training and markings of the fire hazard of overfilling oil, hydraulic, and fuel tanks. Lack of experience with the aircraft servicing is a safety concern. Require supervision of servicing operations and fire safety procedures.	
137.	Fire Guard	Verify maintenance, servicing, preflight, and post flight activities include fire guard precautions. This is a standard USAF/NAVAIR safety-related procedure.	
138.	Engine Start	Verify the AIP includes procedures for documenting all unsuccessful starts.	
139.	Engine Storage and Limitations	Review engine storage methods and determine engine condition after storage. Evaluate calendar time since the last overhaul. Also, Soviet engines may include calendar limitations both in terms of storage and time since last inspection. For example, the use of an engine with 50 hours since a 1991 overhaul may not be adequate and a new overhaul may be required after a specified time in storage. Note: Experimental exhibition of former military aircraft is that engines that have exceeded storage life limits are susceptible to internal corrosion, deterioration of seals and coatings, and breakdown of engine preservation lubricants.	
140.	Wiring Diagram and Inspection	Verify the AIP includes up-to-date wiring diagrams consistent with the appropriate guidance and includes the appropriate inspection procedures. The high complexity of the aircraft somewhat antiquate electrical system is a serious concern. Any reference to the applicable guidance must address modifications. In addition to the appropriate guidance, another reference is NA 01-1AA-505, Joint Service General Wiring Maintenance Manual.	
141.	Engine Foreign Object Damage (FOD)	Verify adoption of an FOD prevention program (internal engine section, external, and air intake). Use and properly inspect the air intake screen (FOD guards) provided with the aircraft and designed for the aircraft. See *Airframe and Engine Covers* below.	
142.	Airframe and Engines Covers	Verify that the AIP provides for and that the operator has the required airframe and engine covers. These are essentials safety items.	
143.	Engine Condition Monitoring (Oil Analysis)	As part of the engine maintenance schedule, recommend an engine Spectrographic Oil Analysis Program (SOAP) be implemented with intervals of less than 5 hours. If baseline data exists, this can be very useful for failure prevention. If manufacturer baseline data does not exist, this may still warn of impending failure. In the HAVE PAD final report (the MiG-23 flight test program), the total engine time was 87 hours. This time represents 58 percent of the time between overhaul for this engine. A higher percentage of copper and iron particles show up in the engine oil. SOAP analysis at the initial portion of the flight test program indicated readings of 3 ppm for copper and 5 ppm for iron. After the last flight, the final readings were 25 ppm for copper and 14 ppm for iron. The higher copper content is believed to be the result of using Mil-7808—synthetic oil. This oil will react to copper content in the lubrication system. The source of high iron content was found to be deterioration of the piston rings on the No. 1 seal. For the latest guidance on SOAPs affecting the J85, refer to Joint Oil Analysis Program Manual, Volume III: Laboratory Analytical Methodology and Equipment Criteria (Aeronautical), (Navy) NAVAIR 17-15-50.3, (Army) TM 38-301-3, (Air Force) TO 33-1-37-3, and (Coast Guard) CGTO 33-1-37-3, dated July 31, 2012. This document presents the methodology for evaluating spectrometric analyses of samples from aeronautical equipment. The methodology enables an evaluator to identify wear metals present in the sample and their probable sources, judge equipment condition, and make recommendations that influence maintenance and operational decisions. Following these recommendations can enhance safety and equipment reliability and contribute to more effective and economic maintenance practices.	
144.	Engine Bleed Air	Verify the AIP includes procedures for inspecting and ensuring the serviceability of the engine bleed air system.	
145.	Broken Systems (Fuel, Oil, and Hydraulic) Lines	Verify the AIP includes procedures for inspecting and replacing fuel, oil, and hydraulic lines according to the applicable requirements. Hydraulic lines issues are not uncommon. A recent inspection on an Indian Air Force MiG-27 illustrates this: "On March 12, 2012, during DI, he [mechanic] observed that the high pressure hydraulic pipe line of EDP was rubbing with the breather pipe line. These pipe lines have a prescribed clearance of just 3 mm with other lines. Prolonged rubbing due to vibration could have resulted in hurting of the hydraulic pipe line during flight leading to a possible accident/incident. He immediately reported the matter and the fault was timely rectified." http://indianairforce.nic.in/fsmagazines/OCTOBER%2012.pdf.	

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146.	Hydraulic Powered Speed Regulator (PGL-30M)	Verify that the AIP covers the inspection, maintenance, and replacement (at the required life-limit) of the PGL-30M Hydraulic Powered Speed Regulator. This is a major safety concern with the MiG-23. This component uses fuel to feed a vanned drive which in turn powers the AC generator. Instead of a gear reduction mechanism to drive the AC generator from the engine rotation, the system uses fuel pressure through a fluid labyrinth to obtain the constant RPM needed by the AC generator. The problem is that the PGL-30M is prone to leaking fuel. This failure has been documented in one of the MiG-23s being restored, and the operator notes that "the MiG-23 doesn't do anything in a small way when it comes to fuel. Until the device was removed it was necessary to put a 150 gallon plastic stock tank under the aircraft to catch the drip." http://blog.cwam.org/search?updated-max=2011-04-24T00:00:00-05:00&max-results=4&start=20&by-date=false.	
147.	Lubrication and Servicing Charts	Recommend that independently of other guidance (i.e., daily inspection), the AIP include detailed lubrication and servicing charts.	
148.	Systems Functionality and Leak Checks (General)	Verify procedures are in place to check all major systems in the aircraft for serviceability and functionality. Verify the leak checks of all systems are properly accounted for in the AIP per the applicable technical guidance and, when possible, per USAF/NAVAIR requirements.	
149.	Hydraulic System Vulnerabilities	Verify the AIP includes detailed information on the inspection(s) of the hydraulic system. The MiG-23 hydraulic system is kept separated through most of the aircraft. Main system components are primarily on the right side, with most boost system components on the left side. Lines from both systems are located close together in some areas: under the afterburner in the tail section, and in the fuselage spine, the wing sweep bay, and the wing gloves where the hydraulics transfers to the moveable wing sections. The two separate hydraulic circuits provide a basic redundancy sufficient for general flight safety; however, they do not allow complete use of all aircraft control systems if the main hydraulic is disabled. When only the boost system is operating, the pilot cannot use the rudder or the air brakes, and the use of differential stabilator deflection for roll control is limited. The boost system does power the stabilators, spoilers, and the wing sweep drive motors. Loss of the boost hydraulic system does not prevent the use of any hydraulic devices, although the speed with which some devices operate may be reduced because of high flow demand. The following narrative illustrates a hydraulic-related incident in a MiG-23UB: "On October 2010, [a mechanic] was detailed as take-off inspector. During his checks on a MiG-23 UB aircraft, he observed minute hydraulic seepage from the starboard main LG door actuating cylinder. Based on his assessment, the mission was aborted and aircraft was returned to the flight line. Had the leak gone unnoticed, it could have lead to a hazardous situation in the air. [The mechanic], despite his limited experience, displayed a keen sense of observation and commitment and helped in averting a potential hazardous situation." http://indianairforce.nic.in/fsmagazines/May11.pdf.	
150.	Fuel System	Verify the AIP includes procedures for inspecting the MiG-23's fuel system. This system is known for leaking and in-flight fires. The MiG-23 consists of six fuselage tanks, six wing tanks, and optional external drop tanks. Maximum internal fuel capacity is 5,318 liters; maximum total fuel capacity is 7,718 liters with three drop tanks. It is capable of single point pressure refueling, with gravity refueling as a back-up. Both in-flight fuel transfer and single-point refueling are automatically controlled. All fuel tanks are pressurized by compressor bleed air. Refer to *Fuel Tank Inspections and Related Structures* and *Fuel System Vulnerabilities* below.	
151.	Fuel Tank Inspections and Related Structures	Verify the AIP includes procedures for inspecting the fuel tanks (and related structures). Deterioration of bladder tanks (bags) and the sealant can pose a safety problem, especially because of the aircraft's age and storage, as well as the difficulty of the inspection (and access to the fuel tanks) itself. Bladder-type fuel tank safety is not necessarily ensured by only "on condition" inspections and may require more extensive processes, including replacements. In any event, adequate data must be provided for any justification to inspect rather than replacing the fuel tanks at the end of their life limit.	
152.	Fuel Tank Inspections T.O. 1-1-3	Recommend that on issues concerning fuel tank inspections, and in addition to the applicable technical guidance, *Inspection and Repair of Aircraft Integral Tanks and Fuel Cells,* T.O. 1-1-3, December 22, 2009, Change 10, February 17, 2013 be also used as a guiding document.	

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153.	Fuel System Vulnerabilities	The fuel tanks are not self-sealing, foam-filled, or inverted. Fuel leakage into dry void areas creates a very serious fire hazard, and fuel leakage into the intake ducts can cause engine failure due to fuel injection. Fuel leakage into the inlet duct could cause engine failure from fuel ingestion, and leakage into the aircraft dry bay areas can lead to fires and explosions. Because the MiG-23 integral tanks are also part of the load-carrying structure, it is also possible that hydraulic ram damage to the fuel tanks could cause a primary structural failure. Fuel leaks in the MiG-23 are not historic; they are current. Case in point, in 2010, a MiG-23 restorer encountered this common issue. It was reported that "the Flogger developed a mysterious fuel system leak after ground test in the spring. Replacement parts have now arrived allowing us to resume…" http://blog.cwam.org/search?updated-max=2010-11-11T00:00:00-06:00&max-results=4&start=40&by-date=false. An Indian Air Force inspection of a MiG-23UB in October 2012 noticed that "while carrying out DI the mechanic noticed a minute fuel leak from the port side of the engine hedge panel. He immediately reported the matter to his superiors. Subsequent investigations revealed that the fuel leak was from the GO-GZ pipeline. Had this leak gone unnoticed, it could have led to a serious accident." http://indianairforce.nic.in/fsmagazines/OCTOBER%2012.pdf. Another Indian Air Force MiG-27 incident was recorded as follows: "On January 4, 2012, Sargent AS Praveen AFSO was detailed to perform the duties of runway controller. During this period a MiG-27 was cleared for take - off. During the take-off roll of the ac, the runway controller observed fuel leakage from the port wheel bay of this aircraft. He transmitted this to the aircraft. Subsequently, the DATCO also gave a call to abandon take-off. The pilot acknowledged the calls and abandoned take off. The aircraft was switched off on the runway and towed back to the dispersal. Subsequent analysis confirmed the fuel leakage." http://indianairforce.nic.in/fsmagazines/1nov%2012.pdf. Another such incident provides more detail on the source of the leak: "On October 28, 2011, Cpl. Deora was detailed to perform the duties of Runway Controller. During this period a MiG-27 aircraft lined up for take off. [He] observed fuel leakage from the starboard undercarriage bay and promptly transmitted it on R/T. The aircraft vacated on the ORP for inspection. The `Take-off Inspectors' found no sign of fuel leakage and the aircraft was cleared to line up for the second time. However, Cpl. Deora insisted on his observation and the aircraft was taxied back to the dispersal. Subsequent checks revealed that there was a fuel leakage from the under carriage bay." http://indianairforce.nic.in/fsmagazines/Jun12.pdf.	
154.	Bladder Fuel Tanks Inspections	Verify the AIP includes procedures for inspecting, and when appropriate, the replacement of the bladder fuel tanks. Soviet bladder fuel tanks had life-limits, usually about 10 years. Deterioration of bladder tank (bag) and the sealant can pose a safety problem, especially because of the aircraft's age and storage, as well as the difficulty of the inspection (and access to the fuel tanks) itself. Bladder-type fuel tank safety is not necessarily ensured by only "on-condition" inspections and may require more extensive processes, including replacements. In any event, adequate data must be provided for any justification to inspect rather than replacing the fuel tanks at the end of their life limit. The issue is to get acceptable tech data (i.e., inspection results and findings, USAF inspection guidance) to somehow validate some level of continuing the use (with a limit) beyond manufacturer's calendar limit. The need is to go beyond just "it's fine because it does not leak" or "the Soviet life-limit is bogus…" An acceptable process may include the following: • A reasonable periodic inspection schedule. This inspection would not be a requirement that runs in perpetuity. For example, the inspection could be done at 5 years initially, then each 4, and so on. The idea is to move carefully with the understanding that there will be a point at which safe operation can no longer be assured. • To include the actual removal of the cells for inspection like you guys have done; • Inspection procedures and the technical basis of the inspection(s) would be to acceptable technical standards, i.e., USAF Tech Oder on fuel cells with the appropriate references, i.e. type of cells, type of material, type of storage, type of fittings. • Use *Inspection and Repair of Aircraft Integral Tanks and Fuel Cells,* T.O. 1-1-3, December 22, 2009, Change 10, February 17, 2013 as the main guiding document. • Provide for adequate/acceptable storage requirements, i.e., "not outdoors for years" or "sitting empty for long periods of time." • Document Reliability Centered Maintenance (RCM) concepts and data, that is, the inspection program becomes a living document that can be adapted or adapt to what is found in terms of the inspection(s).	
155.	Oil, Fuel, and Hydraulic Fluids	Verify procedures are in place to identify and use a list of equivalents of materials for replacing oil, fuel, and hydraulic fluids. Many operators include a cross-reference chart for NATO and U.S. lubricants as part of the AIP. This is critical in the MiG-23 because there have been cases where the wrong fluid, acceptable as a standard in the United States, was used in Soviet equipment and causing serious damage, notable to the engine, seals, and other components.	

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156.	Electrical System and Batteries	Ensure the AIP addresses the functionality of the generator(s) and the compatibility of the aircraft's electrical system with any new battery installation or other system and component installation or modification. Avoiding overload conditions is essential. Note: As part of the inspections of the aircraft's electrical system, which were not a simple affair, a *Circuit Analyzer* and an *Analyzer Module Assembly* were used. In the MiG-23, the electrical system is mission critical, but a safe flight will still occur if both the AC and DC generators are not functioning. The following are some of the devices that would be out of service if there is a generator loss: <u>DC Generator</u> • Tank 1 pump • Tank 1A pump • Tank 3 pump • 1 (one) Tank 2 pump • Ordnance arming equipment • Data link • Brakes • Brake chute <u>AC Generator</u> • Data link • SAU Automatic Control System • IFF	
157.	Fuses	Verify that the AIP provides for the inspection, maintenance, and replacement of the fuses (approximately 100) in the electrical system. The AIP needs to address any limitations these may have as well as provide for the source of any replacements.	
158.	Borescope Engine	Recommend the AIP incorporate borescope inspections of the engine at 25 hours per the applicable inspection procedures. AC 43.13-1 can be used as a reference.	
159.	Pitot/Static, Lighting, and Avionics and Instruments	Verify compliance with all applicable 14 CFR requirements (that is, § 91.411) concerning the pitot/static system, exterior lighting (that is, adequate position and anti-collision lighting), transponder, avionics, and related instruments.	
160.	Pitot Tube	Verify the AIP addresses the proper inspection of the pitot tube system.	
161.	Oxygen System	Emphasize inspection of the oxygen system and any modifications, which are very likely in the MiG-23. Compliance with § 91.211, Supplemental Oxygen, is required. Recommend adherence to § 23.1441, Oxygen Equipment and Supply. Moreover, per FAA Order 8900.1, change 124, chapter 57, Maintenance Requirements for High-Pressure Cylinders Installed in U.S. Registered Aircraft Certificated in Any Category, each high-pressure cylinder installed in a U.S.-registered aircraft must be a cylinder manufactured and approved under the requirements of 49 CFR, or under a special permit issued by the Pipeline and Hazardous Materials Safety Administration (PHMSA) under 49 CFR part 107. There is no provision for the FAA to authorize "on condition" for testing, maintenance, or inspection of high-pressure cylinders under 49 CFR (PHMSA).	
162.	Other Pressure Cylinders (That Is, Nitrogen)	Emphasize the proper inspection of any pressure cylinders. Per FAA Order 8900.1 change 124, chapter 57, each high-pressure cylinder installed in a U.S.-registered aircraft must be a cylinder that is manufactured and approved under the requirements of 49 CFR, or under a special permit issued by PHMSA under 49 CFR Part 107. There is no provision for the FAA to authorize "on condition" for testing, maintenance or inspection of high-pressure cylinders under 49 CFR. For example, the fire bottles are time sensitive items, and may have a limit of 5 years for hydrostatic testing. The issue is when the bottles are removed from the aircraft. It is industry knowledge that non-U.S. bottles may be installed as long as they are within their hydrostatic test dates. A problem arises when removing the bottles for hydrostatic testing. Maintenance programs require these bottles to be hydrostatic tested. Once the non-U.S. bottles are removed from the aircraft, they are not supposed to be hydrostatic tested, recharged, or reinstalled in any aircraft. Moreover, those bottles cannot be serviced (on board) after the testing date has expired.	
163.	Anti-G Suit System	Verify the serviceability of both aircraft systems (that is, anti-G valve) and the anti-G suit, if installed. Verify any U.S. equipment used is properly integrated through adequate testing and data.	

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164.	Pressurization Vessel and Environmental Control	Verify the AIP incorporates the inspection of the pressurized sections of the aircraft per the appropriate technical guidance. Note pressure cycles and any repairs in the area. Verify the AIP incorporates related documentation and manuals.	
165.	Pneumatic System	The AIP needs to emphasize the inspection of the pneumatic system and any modifications. Unlike many Western aircraft, Soviet design philosophy included a significant number of pneumatic systems, and thus, many critical systems in the aircraft are pneumatic.	
166.	Cockpit Instrumentation Markings	Verify all cockpit markings are legible and use proper English terminology and units acceptable to the FAA. Some operators do not even translate the cockpit instrumentation to English, and this is a serious safety issue. The AIP should address inspection of all cockpit instruments with regular intervals for each subsystem. Care should also be taken to inspect modifications, including communications, navigation, or other upgrades to the cockpit. The AIP should address cockpit indicators calibration processes to ensure accurate indications for essential components. Note: All MiG-23 instrumentation uses the metric system.	
167.	Warning and Caution Light System (Annunciator Panel)	Ensure the AIP includes steps to verify and maintain the integrity of the caution light systems (including the annunciator panel) in the aircraft. The system must be in English. The following account by a MiG-23 restorer explains some of the details of the system: “The main panel can be removed with a single screw, making it easy to change the 28-volt light bulbs behind it. The "day/night" knob adjusts the brightness of the lights and doubles as a "push to test" button that illuminates all bulbs so the pilot can check if they're burned out. The brightness adjustment knob carries through the "push to test" action to a button behind the panel. A spring returns the knob to its normal position. The panel is continuously adjustable from fully bright "day" mode to a very dim "night" mode. Unusually, this is done with a mechanical slider that blocks the amount of light coming to the panel rather than by regulation of the voltage intensity being applied to the lights. There are two primary panels. One dealing with engine issues and one primarily dealing with the six fuel tanks (plus external drop tanks) that are automatically managed for the pilot. Additionally, a panel of "trim neutral" green lights and a set of information lights on the gear tree need to be translated. The MiG-23's unique "swing wing" design is brought up on the panel's "SPREAD WINGS" light. As it is virtually impossible to land the MiG-23 with the wings swept to any degree at all this light exists to alert pilots to the danger that the gear have been lowered and the wings are not in the full forward position. Red tiles illuminate for emergency situations (fire, loss of an electric generator, or very low fuel state), yellow for situations needing the pilot's attention (hydraulic system anomalies), and green for information not requiring action (such as when a fuel tank reaches an empty state). Additionally a master caution annunciator and two red master caution lights are placed in the pilot's "heads up" field of view. The blinking of the master caution system can be canceled by pressing the master caution annunciator light/button.” http://blog.cwam.org/search?updated-max=2010-03-05T18:00:00-06:00&max-results=4&start=80&by-date=false.	
168.	Natasha Warning System	If installed in the aircraft, verify the AIP addresses the proper maintenance and inspection of the voice activated emergency warning system called “Natasha.” This distinctive female voice, helps drawing attention of the pilot so that recovery actions were promptly initiated.	
169.	Autopilot	If installed, the AIP needs to address the maintenance and inspection (and functionality) of the autopilot. Many MiG-23 accidents have been caused by autopilot malfunctions. See *Autopilot Functions, and Dangerous Altitude Recovery* below.	
170.	Avionics/Equipment Bay Aft of the Cockpit	Verify that the AIP and SOPs provide for the inspection of the avionics/equipment bay aft of the cockpit. This area was not completely sealed against moisture, and water condensing inside can seep into the electric connectors and cause short circuits.	
171.	Safety Markings and Stenciling (NATO Standard)	Verify appropriate MiG-23 safety markings and stencils required by the technical manuals (i.e., that is, warning notes, “Remove Before Flight” banners) and to NATO standards have been applied and are in English. These markings provide appropriate warnings/instruction regarding areas of the aircraft that could be dangerous. These areas include intakes, exhaust, air brakes, and ejection seats. In the case of ejections seat systems, and as noted in FAA Order 8130.2, paragraph 4074(e), “a special airworthiness certificate will not be issued before meeting this requirement.”	
172.	Maintenance and Servicing Markings and Stenciling (NATO Standards)	Verify appropriate MiG-23 maintenance and servicing markings and stencils required by the technical manuals and to NATO standards have been applied and are in English. It includes “Remove Before Flight” banners. These markings provide appropriate warnings/instructions regarding specific maintenance and servicing of the aircraft that are critical to safety.	
173.	Cockpit FOD	Verify the AIP addresses thorough inspection and cleaning of the cockpit area to preclude inadvertent ejection, flight control interference, pressurization problems, and other problems. This is a standard USAF/NAVAIR practice.	

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174.	Tires and Wheels	Verify use of proper tires and/or equivalent substitutes (including inner tubes) and adherence to any tire limitation, such as allowed number of landings, inflation requirements, and the use of retreaded tires. The type of tire may dictate the number of landings. Wheels must be properly and regularly inspected and balanced. Many former military high-performance aircraft have a long history of tire failures, one of the leading causes of accidents. The following account of a tire change in a MiG-23 during restoration provides good insight into this critical system: "Following the taxi test, we began noticing that the port tire was losing pressure. We had anticipated replacing the tires that came with [the aircraft] and fortunately, our replacement set was already on hand. A particularly handy thing is to keep a spare tire already mounted on a spare rim to minimize the time needed to "rescue" an aircraft in case a tire should "blow," or go flat during operations. One of our "spares" was already mounted on a rim, simplifying this replacement process. However, this did not eliminate the need to read the instructions. The MiG-23 wheel assembly consists of approximately 60 individual components, not including nuts and washers. The massive disk brake mechanism incorporates an anti-skid system and uses six big rotors and seven heavy-duty stators in each wheel. The amount of heat that can be generated by the brakes poses a serious bursting issue with the tires. To prevent this, the designers incorporated two interesting features. The first is an electric fan. Mounted in the center of the axle, the fan activates when the "weight on wheels" switch signals that the aircraft is once again on the ground. A keeper ring goes between the fan mounting bolts and the axle to keep the fan and the nut from turning as the tire turns. In the picture below, Jon is inspecting the electrical connection for the fan motor in the center axle. The second feature is a solder plug that melts at 140°C, allowing pressure to escape before the tire can burst. On fast landings or after any extensive brake use, MiG-23 pilots may alert their ground crews so the wheels can be doused with water so the plug doesn't melt." http://blog.cwam.org/search?updated-max=2010-02-24T00:00:00-06:00&max-results=4&start=84&by-date=false.	
175.	Explosives and Propellants	Check compliance with applicable Federal, State, and local requirements for all explosives and propellants in terms of use, storage, and disposal, in addition to verifying service (USAF) requirements are followed.	
176.	HAZMAT	Recommend the AIP incorporates adequate provisions on HAZMAT handling. Refer to Gamauf, *Handling Hangar Hazmat*, August 2012.	
177.	Canopy System	Verify the MiG-23 canopy system is functional and properly inspected per the applicable technical guidance. As an example, during a recent MiG-23UB restoration, and during a canopy test, the operator found that "although the front canopy locks are stuck in the *open* position and, worse, the rear ones are stuck in the *closed* position. We're evaluating multiple options before we try removing the Plexiglas to break in… Got a connection backwards on the canopy opening control valve?" Refer to http://blog.cwam.org/2009/01/mig-23-canopy-woes.html. Note: The MiG-23 canopy is a pneumatically operated clamshell that is hinged aft for access to the cockpit. The windshield is flat and is made up of two layers of glass for a total thickness of 19 mm. The side panels are single pane sections and are 12 mm thick. The hinged canopy is 10 mm thick. An independent, emergency air-operated jettison system is used on the MiG-23.	
178.	In-Flight Canopy Separation	Ensure the AIP addresses the proper maintenance and operating condition of all canopy locks. On March 20, 1993, an IAF MiG-23 had its aircraft canopy detach in flight. This problem is also confirmed when the Red Eagle squadron encountered fatigued or failing canopies. An independent, emergency air-operated jettison system is available on the MiG-23.	
179.	Canopy Seals	Test canopy seals for leaks (that is, use ground test connection).	
180.	Transparencies Problems	Ensure proper transparencies maintenance for safe operations. Monitor/inspect canopy for crazing every 10 hours of flight. Canopy failures, de-laminations, and Plexiglas deterioration are common with Soviet Bloc transparencies. Procedures should address this in the AIP and as part of post-flight procedures.	
181.	Emergency Canopy Jettison Mechanism	Verify the AIP includes testing the emergency canopy jettison mechanism, if so equipped. It must be functional and properly inspected per the applicable technical guidance.	
182.	Brake System	Emphasize a detailed inspection of the brake assemblies, adhere to applicable inspection guidelines and replacement times (that is, USAF, NAVAIR, NATO, or RAF), and consider more conservative inspections. Recommend brake inspection at 20 to 30 landings.	
183.	Hoses and Cables	Inspect and replace hoses and cables appropriately. Due to the age of many of the former military high-performance aircraft, and in many cases, poor storage history, it is essential to ensure thorough inspections of all hoses and cables (multiple systems) and replace them in accordance with the guidance and requirements. Appropriate documentation should be provided if non-Soviet replacements are used.	
184.	Grounding	Verify adequate procedures are in place for grounding the aircraft. Static electricity could cause a fire or explosion, set off pyrotechnic cartridges, or result in any combination of the above. In grounding the aircraft, it is essential that all electrical tools are grounded, and industry-approved explosion-proof flashlights or other lighting sources be used.	

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185.	TO 00-25-172	Use TO 00-25-172, Ground Servicing of Aircraft and Static Grounding/Bonding, dated August 2012, as the baseline for all servicing functions. This manual describes physical and/or chemical processes that may cause injury or death to personnel, or damage to equipment, if not properly followed. This safety summary includes general safety precautions and instructions that must be understood and applied during operation and maintenance to ensure personnel safety and protection of equipment.	
186.	Angle of Attack (AOA) System	Ensure that the AIP covers the adequate inspection and calibration of the AOA system, AOA limiter, and AOA "warning system." In Soviet terminology, the system is called a SOUA which stands for "angle of attack limiter." Note: Upgraded versions incorporated the SOS-3-4 synthetic "stick-stop" or the so-called soft pitch/AOA limiter, which restricts G, angle of attack, and pitch rate.	
187.	Antennas	Verify any original antennas are compatible with all installed electronics. In addition, verify the AIP includes the appropriate inspections of the antennas. Some new avionics may impose airspeed limitations. Over the years, many different antennas were installed in this type of aircraft. For the basics on this issue, refer to Higdon, David. Aircraft as Antenna Farm. *Avionics,* Vol. 49, No. 9 (September 2012).	
188.	Hard Landings and Over G Situations	Verify hard landing and over-G inspection programs are adopted.	
189.	Nondestructive Inspection (NDI)	Ensure the AIP provides for all the required NDI or nondestructive testing under the appropriate guidance. USAF, NAVAIR, or NATO guidance an also be used as a reference when appropriate.	
190.	Rivets on Load Areas	Verify the AIP incorporates the inspection of all rivets in critical load areas such as trailing edges where inspections regularly noted loose rivets.	
191.	Exhaust Trail Areas	Verify that the AIP includes the proper inspection of the exhaust trail areas. Engine exhaust deposits are very corrosive and give particular trouble where gaps, seams, hinges, and fairings are located downstream from the exhaust pipes or nozzles. For example, "deposits may be trapped and not reached by normal cleaning methods. Pay special attention to areas around rivet heads and in skin lap joints and other crevices. Remove and inspect fairings and access plates in the exhaust areas. Do not overlook exhaust deposit buildup in remote areas, such as the empennage surfaces. Buildup in these areas will be slower and may not be noticed until corrosive damage has begun." http://www.faa.gov/library/manuals/aircraft/amt_handbook/media/faa-8083-30_ch06.pdf.	
192.	Variable Sweep Wings	Ensure the AIP provides for the inspection and replacement (of components) of the variable sweep wings and components. Structural issues, namely cracks, were common. Note: The MiG-23's variable sweep wing has a range from 16 degrees at the forward sweep to 72 degrees at the aft sweep position. Intermediate settings are possible but only three detents are provided. Sweep is 3.1 degrees per second or about 18 seconds for full sweep. Loss of one hydraulic system will double the sweep time because of the loss of one hydraulic motor.	
193.	Leading Edge Slats	Ensure that the AIP provides for proper slat condition and functionally (i.e., lubrication, freedom of movement of the rollers, re-alignment). The wing slats may stick and create asymmetric lift during maneuvering.	
194.	Wings and Tail Bolts and Bushings	Ask about inspections and magnafluxing of wings, and tail bolts and bushings. Recommend the AIP incorporate other commonly used and industry-accepted practices involving NDI if not addressed in the manufacturer's maintenance and inspection procedures.	
195.	Horizontal Stab Bearing Inspection and Lubrication	Ask if the AIP includes required inspections and maintenance of the horizontal stab bearings. Failure to properly lubricate/inspect the bearings or improper reinstallation could result in loss/failure of the bearings and in-flight loss of control.	
196.	Landing Gear Retraction Test and Related Maintenance	Verify the AIP provides for the regular landing gear retraction test and related maintenance tasks, including documentation, per the applicable procedures and required equipment. The MiG-23 has a very rugged yet complex tricycle landing gear. Note: The main and nose gears have trailing arm designs and each leg has a wheel fairing or door to reduce Foreign Object Damage (FOD) or water spray. The gear is operated by the main hydraulic system and has a pneumatic emergency lowering capability. Verify the AIP incorporates proper maintenance and inspection of wheels, including balancing. The following narrative illustrates the value of landing gear inspections, not only of scheduled, but also daily and pre-flight inspections: "On July 1, 2009, [the mechanic] was detailed as aircraft inspector on a MiG-21 (T-96) aircraft. During final inspection of the aircraft for a sortie, he noticed the split pin of the bolt holding the bracket to the fork of the nose oleo missing and indicated the same to the pilot for aborting the mission." http://indianairforce.nic.in/fsmagazines/Dec09.pdf.	

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197.	MiG-23/MiG-27 Main Landing Gear Life-Limit	Verify the AIP addresses the life-limit of the MiG-23/MiG-27 main landing gear. In some cases, as with those in the Indian Air Force, they have been extended by developing rejuvenation technology. However, if any such "extensions" are sought, adequate technical data is required. See http://hal-india.com/. The following account illustrates the nature of some of the life-limit related landing gear issues with the MiG-23/27: "On March 4, 2010, [a mechanic] was detailed to change the life expired Main Landing Gear of a MiG-27 aircraft. During the checks he noticed a minor crack on the starboard LG beam (part of fuselage structure) near frame No 20. Subsequent inspection and dye penetrant test revealed a large crack of length 125 mm (horizontal) and approximately 50 mm (vertical). Had this crack gone unnoticed, it could have resulted in landing gear collapse and subsequent loss of aircraft/human life." The mechanic displayed keen observation & high degree of professionalism in averting a potential accident." http://indianairforce.nic.in/fsmagazines/Oct10.pdf.	
198.	Wheel Brake System	Verify the AIP address the inspection of this system. The MiG-23 wheel brake system consists of segmented air-operated disc brakes on both the main and nose wheels. Rotating segmented discs of plate steel containing sintered cast iron form the wearing surface. The segmented stationary discs are composed of a steel frame faced with machined steel friction-bearing plates. The wheel brakes are actuated by compressed air from the pneumatic system with an alternate emergency air system and separate control provided. The amount of braking is controlled by a brake handle mounted on the aircraft control stick. Directional control is provided by differential braking through the rudder pedals; that is, as one pedal is pushed, the brake pressure on the opposite wheel is decreased.	
199.	Brake Thermal Plugs Cooling	Verify that the AIP and related support and servicing SOPs provide for ground crew to apply the water hoses after landing. This may be upon reaching the ramp so that the ground crew can use hoses on the brakes to keep the wheels from blowing out the thermal plugs. A civil MiG-23 pilot noted following a test flight that "upon parking 2 mechanics were standing by with 5 gal pails of water for the brakes. As we climbed out the wheels were steaming from the water, very different." http://www.warbirdsofdelaware.com/Airplanes/MiG23/MiG23PilotReport/tabid/87/Default.aspx.	
200.	Anti-Skid System	Verify the AIP address the inspection of this system. The MiG-23 has an automatic antiskid protection used on all wheels. This system provides for maximum braking under all operating conditions without any danger that the wheels will skid or that the braking will cause other damage.	
201.	Ventral Fin	Verify that the AIP contains the necessary inspections and maintenance of the foldable ventral fin under the tail. This important surface is retracted for take-off and landing and extends in flight. It is a required item for flight stability. The MiG-23 has a ventral fin for added stability in flight. It has to be folded during take-off and landing and on the ground. Its retraction is tied to the landing gear system, in that it automatically extends when the gear is retracted and retracts when the gear is extended.	
202.	Honeycomb Structures	Verify the AIP provides for the inspection and replacement of all bonded honeycomb structures per the applicable guidance. Note: Soviet honeycomb structures may be very different from U.S. types.	
203.	Steel Components	The AIP must address the inspection and maintenance of all steel components. As with many Soviet aircraft, the MiG-23 has a significant amount of steel components, including major structural elements, many embedded within aluminum structures. One such area is the vertical stabilizer. Some of these steel components re located in areas not usually found in Western aircraft. The issue of aluminum/steel corrosion is critical. Note: <u>Dissimilar Metal Corrosion.</u> Extensive pitting damage may result from contact between dissimilar metal parts in the presence of a conductor. While surface corrosion may or may not be taking place, a galvanic action, not unlike electroplating, occurs at the points or areas of contact where the insulation between the surfaces has broken down or been omitted. This electrochemical attack can be very serious because in many instances the action is taking place out of sight, and the only way to detect it prior to structural failure is by disassembly and inspection. The contamination of a metal's surface by mechanical means can also induce dissimilar metal corrosion. The improper use of steel cleaning products, such as steel wool or a steel wire brush on aluminum or magnesium, can force small pieces of steel into the metal being cleaned, which will then further corrode and ruin the adjoining surface. Carefully monitor the use of nonwoven abrasive pads, so that pads used on one type of metal are not used again on a different metal surface. Refer to FAA 8083-30, Chapter 6, and FAA Advisory Circular (AC) 43-4A, Corrosion Control for Aircraft.	
204.	Flight Control Balancing, Deflection, and Rigging	Verify flight controls were balanced per the applicable maintenance manual(s) after material replacement, repairs, and painting. Verify proper rigging and deflection. In several former military aircraft, damage to flight controls has been noticed when inadequate repairs have been performed. If there are no adequate records of the balancing of the flight controls, the airworthiness certificate should not be issued.	
205.	Flight Control System	Verify the AIP provides for the regular inspection of the flight control system. Note: The MiG-23 flight control system consist of the differential stabilator, spoilers, rudder, wing sweep unit, wing leading edge flaps, wing trailing edge flaps, folding ventral fin, and speed brakes. Flight controls are hydraulically powered and have an automatic flight control system that provides boost, damping, trimming, and stabilization. This flight control system has no redundant components; all components are critical. Loss of one hydraulic system results in complete loss of aircraft control. There is a back-up hydraulic system to activate flight control actuators. Electrical power is required to operate the automatic control system, but is not needed for basic control by the pilot.	

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206.	Flight Controls System	Verify that the AIP provides for the inspection and maintenance of all flight control rods as per the applicable guidance. The AIP should have comprehensive guidance to this effect, including the layout of the system and components.	
207.	Flight Control Rods	Verify that the AIP provides for the proper flight controls rods. These will be of varying types, length, diameters, and thickness.	
208.	Boosters	Verify that the AIP provides for the inspection, maintenance, and replacement of the flight control boosters.	
209.	SARPP-12GM and BUR-4-1	If installed, verify that the AIP addresses the automatic recording of flight parameters SARPP-12GM-board emergency and operational flight data recorders BUR-4-1. These instruments may yield significant benefits in enhancing safety since data, including flight parameters and instrumentation may be downloaded for review.	
210.	Pneumatic Systems	Verify the AIP provides for the inspection (and replacement of components) of the pneumatic system. Unlike many contemporary U.S. types, the MiG-23 is heavily dependent on pneumatic systems for many critical systems. The MiG-23 has two pneumatic systems operating the following devices: <u>Main System</u>: • Canopy Lift & Sealing • Brakes • Fuel Shut-off Valve • Brake Chute door & Chute ejection • Wing/Fuselage Fillet (Sealing) Flaps • AI radar Pressurization • Avionics Cooling Doors • Emergency Hydraulic Pump Switchover <u>Emergency System</u>: - Emergency Landing Gear Extension - Emergency Ventral Fin Retraction - Emergency Brakes Both systems are located in the left gear well. Compressed air is stored in five separate cells with a total of 29 liters. All cells are protected by non-return valves to prevent their depletion due to damage to other parts of the system. Refer to *Pneumatics Vulnerabilities* below.	
211.	Pneumatics Vulnerabilities	Failure of MiG-23 pneumatic devices should not jeopardize basic in-flight safety, but it may prevent the use of certain equipment. If the lines carrying compressed air to the AI radar fail, it will prevent pressurization of the AI radar coolant tank and other components, preventing use of the radar. The canopy sealing ring is protected by a non-return valve; therefore, damage to the supply line will not cause cabin depressurization. If any of the pneumatic lines fail, they will prevent the operation of that specific component, and may delete the system air supply, but should not endanger the aircraft. Almost all pneumatic lines are located on the bottom of the fuselage. The following Indian Air Force account is an example of the issues with the aircraft's pneumatic systems: " On February 26, 2010, Sgt. Balan was detailed to carry out acceptance check of a MiG-27 ac as part of 400-hours scheduled servicing. During the checks he observed two half line cracks of 25-30 mm length behind pneumatic pipelines, on frame No-22 on both port and starboard side of aircraft. As these are major load bearing frames, had this gone unnoticed it might have led to a catastrophic accident. Sgt. Balan displayed keen sense of observation and a high degree of professionalism in averting a potential accident/incident." http://indianairforce.nic.in/fsmagazines/Oct10.pdf.	
212.	Speed Brakes	Verify proper condition, deflection, and warning signage of the speed brakes per the applicable guidance.	
213.	Yaw Damper	Verify the yaw damper is addressed in the AIP per the applicable guidance.	
214.	Accurate Weight & Balance (W&B)	Review original MiG-23 W&B paperwork. Verify adherence to the applicable guidance as well as FAA-H-8083-1, Aircraft Weight and Balance Handbook, if documentation by the applicant appears to be inadequate. Several former military aircraft accidents have been linked to center of gravity miscalculations. Moreover, the fact is that many pieces of equipment installed in the aircraft when the aircraft was in military service are either removed or replaced and thus an accurate W&B is necessary. For example, the original wing, but without claws, seems to have been fitted to the two UB prototypes. This may indicate the MiG-23UB prototype marked an interim step between the MiG-23S and the MiG-23M, with the latter aircraft being phased out on the airframe and engine improvements of the two-seater, coupled with the full-up weapons system and radar. Production two-seaters all had the No. 3 wing, allowing the aircraft to carry three external fuel tanks.	
215.	"Experimental" Markings	Verify the word "EXPERIMENTAL" is located immediately next to the canopy railing, on both sides, as required by § 45.23(b). Subdued markings are not acceptable.	

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216.	N-Number	Verify the marking required by §§ 45.25 and 45.29(b) concerning the registration number (N-number), its location, and its size are complied with. If non-standard markings are proposed, verify compliance with Exemption 5019, as amended, under regulatory Docket No. 25731.	
217.	Type of Ejection Seat System	Identify the type of ejection seat fitted to the aircraft, that is, the KM-1M ejection seat. The type of seat changes many aspects of operations and maintenance. This ejection seat is designed to operate from 70-540 knots at altitudes from Ground level to over 18,000 m. The operator must understand the operating limitations and maintenance requirements with this seat if installed on the MiG-23 aircraft and the rear cabin ejection seat, if the two-seat variant is applicable (that is, MiG-23UB).	
218.	OEM Ejection Seat Support	Ask the applicant whether the ejection seat OEM still supports the ejection seat system, and whether it control part supplies. It is critical to clearly understand if and how the OEM supports both the earlier or upgraded ejections seat.	
219.	Ejection Seat System Maintenance	Ensure maintenance and inspection of the ejection seat and other survival equipment is performed in accordance with the applicable guidance by trained personnel. Include specific inspections and recordkeeping for pyrotechnic devices. Ejection seat system replacement times must be adhered to. No "on condition" maintenance may be permitted for rocket motors and propellants. Make the distinction between replacement times, that is, "shelf life" vs. "installed life limit." For example, a 9-year replacement requirement is not analogous to a 2-year installed limit. If such maintenance documentations and requirements are not available, the seat must be deactivated.	
220.	Ejection Seat Components Life Limit	Ensure life-limit requirements concerning the ejection seat are followed. No deviations or extensions should be permitted. If the seat is not properly maintained, including current pyrotechnics, it must be disabled. There is history of KM-1 ejection seat pyrotechnics malfunctioning. For example, on June 10, 1992 the pilot of a MiG-21MF was killed following a loss of control when the ejection seat system failed. After the accident, and following the inspection of other KM-1 ejection seats, the Czech Air Force determined that some pyros would fail.	
221.	Crew Harnesses	Verify the harness used by the crew is the required type for the ejection seat used. Accidents have been fatal because of harness issues.	
222.	Ejection Seat System Maintainers Training	Require adequate ejection seat training for maintenance crews. On May 9, 2012, an improperly trained mechanic accidentally jettisoned the canopy of a former military aircraft while performing maintenance and was seriously injured. Experience with one seat type does not verify safety with another. Properly identifying the type of ejection seat fitted to the aircraft (presumably a KM-1M ejection seat) and understanding the operating limitations and maintenance requirements is essential for the MiG-23 aircraft. In August 28, 1987, a Red Eagles MiG-23 crashed and the pilot ejected safely. They discovered after the accident that they should have adjusted interlock-like block (seat not going through the canopy) and the barometer in the seat was not adjusted properly. They stated they had a lot to learn regarding the technical data and manuals regarding a Soviet-built ejection seat.	
223.	Ejection Seat Modifications	Prohibit ejection seat modifications unless directly made by the manufacturer or permitted under the applicable and current technical guidance.	
224.	Ground Support Equipment Maintenance	Verify the AIP provides for the proper maintenance of all required approved ground support equipment for the MiG-23 aircraft. Related technical guidance must be available as well.	

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MiG-23 Operating Limitations and Operational Issues			
225.	AIP and Related Documentation	Require adherence to the AIP and related documentation as part of the operating limitations.	
226.	Understanding of the Operating Limitations	Require the applicant to sign the Acknowledgment of Special Operating Limitations form.	
227.	Pilot in Command (PIC) Requirements	Ensure the operating limitations address PIC requirements. Direct transition from a modern corporate jet to a high-performance former military aircraft with minimum training is not a safe practice. Refer to the appropriate plot training and checking requirements in FAA Order 8900.1, volume 5, chapter 9, section 2. In addition to holding the required Experimental Authorization, airplane category, the MiG-23 PIC should have (1) 20 hours dual training in the MiG-23UB in preparation for pilot authorization flight check, (2) a structured ground school (similar to at least an USAF Short Course), (3) 1,000 hours in high-performance fighter/fighter-bomber experience, including experience in second generation aircraft such as the MiG-21, T-38 and F-4 (F-16, F-18, and F-15 can be used for the total), (4) proficiency and currency of 3-5 hours per month and 5-6 takeoffs and landings, (5) follow standard USAF proficiency standardization check procedures (see below). Note: In the Hungarian Air Force, only experienced MiG-21 pilots were assigned to MiG-23 squadrons. Experience with only straight-wing jets, such as the L-39 or T-33 is not sufficient. Illustrating the challenges of flying a MiG-23, in 2007, an IAF Air Chief Marshal Major noted that "whilst being immensely capable, it was also not easy to fly. It had tremendous thrust, its handling characteristics at high angles of attack were tricky, to say the least. And there was one other thing - landing the MiG-23BN? It separated the men from the boys and has been the stuff of many bar-room yarns." Note: In active service with the East German Air Force, MiG-23 pilots flew between 60 and 120 hours annually. Following the collapse of the Soviet Union, many former Warsaw Pact MiG-23 operators had limited flight time available, and in the case of the Hungarian Air Force, MiG-23 pilot flew about 30 hours annually, which was considered insufficient maintain an adequate level of proficiency. This was such an issue, that some admitted being scared by the aircraft because of this. With facts such as this, it becomes apparent that the typical flight currency maintained by civil MiG-23 operators in the US is not adequate. Retired Air Force Lt. Col. Myers, who flew the MiG-23 for the USAF, “pulled no punches when talking about the lack of safety margin for the Flogger. There's only one airplane I've ever been afraid of, and that's the MiG-23. That thing was trying to kill you from when you started it to when you shut it down. I never flew an airplane that didn't give some indication it was going out of control, and this thing did not give any warning. On top of the Flogger's Jekyll and Hyde handling characteristics, Myers said the MiG-23 canopies had a nasty tendency of imploding under vigorous air-combat maneuvers.” http://www.jber.af.mil/news/story.asp?id=123314594. A Soviet MiG-23 pilot put it simply, and noted that the MiG-23 “was a bastard of an airplane to master…” Zuyev, 1992. To illustrate the level of complexity of the aircraft and training requirements, in Romanian Air Force service, a 3-month training course was undertaken for pilots, and when applicable, technical staff as well. The fact remains, those MiG-23 operations should not be undertaken with minimal training. When the MiG-23 was introduced in Iraqi Air Force service in 1974, the minimum experience for the pilots assigned to training was 1,500 hours on fast jets. However, because the Soviet Union provided insufficient training and documentation, these pilots, mostly with extensive MiG-21 experience found themselves involved in many accidents early in the aircraft’s operational career. Mostly, the accidents were due to the negative transfer of MiG-21 handling knowledge to the MiG-23.	
228.	Recent Flight Experience	Recommend proficiency and currency of 3 to 5 hours per month and 5-6 takeoffs and landings. The typical general experience of “at least three takeoffs and three landings within the preceding 90 days” is not sufficient for the safe operation of the MiG-23 aircraft. Recommend proficiency and currency of 3 hours per month and 5-6 takeoffs and landings. Case in point, the operator of a MiG-23UB in the US reported in 2011 that the aircraft has only flown 28 hours since it received its airworthiness certificate in 1998. This amounts to 2.15 hours per year, and is definitely inadequate to maintain any level of proficiency in the aircraft and ensure an acceptable level of safety. Note: Some flexibility could be provided in addressing this issue such as combining hours and landings (that is, 1 hour and 3 landings) and interjecting (but not replacing all MiG-23 flights with the specified period) certain high-performance flight profiles in another high-performance military jet such as the MiG-21UB, TA-4J, or T-38.	
229.	PIC Currency in Number of Aircraft	Recommend the operator limit the number of tactical jets the MiG-23 PIC stays current on. The USAF and USN restrict the number of aircraft types a pilot could hold currency on to two or three. This should be considered by operators who have several aircraft types in their inventory.	
230.	Flight Manuals	Ensure the PIC operates the aircraft as specified in the most current version of the flight manual (that is, USAF -1 or equivalent) in English (a true and accurate technical translation, not an academic one) for the version of the aircraft being flown. It is essential to ensure no “homemade” manuals, even those provided by so-called “experienced restorers” be used. It is incorrect to assume that MiG-23 versions’ flight manuals are interchangeable, especially from the various countries that operated them. Although the aircraft may be similar in design and from a systems standpoint, and even from a flight characteristics perspective, they remain separate aircraft and their differences must be properly addressed, that is, engine and ejection seat system.	

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231.	Checkout Procedures	Recommend establishing a pilot checkout certification process similar to the USAF/NAVAIR/NATO, as part of the Experimental Authorization. This training should include a structured ground school process and documentation covering the operation of the aircraft with an emphasis on emergency procedures. Training should be provided by qualified (FAA certificates) personnel with operational MiG-23 experience.	
232.	Annual Checkout	Recommend the PIC conduct an annual checkout on the aircraft.	
233.	MiG-23 Differences Training	The applicant/operator should provide for and the PIC should have differences training between MiG-23 models. This is not just limited to the single vs. the two seater versions. There are many differences between models, including engine, equipment, instrumentations, and flight characteristics. For example, the MiG-23MLD had a much-improved maneuvering performance (and hence vulnerabilities) than previous versions, thanks to a host of airframe and flight control system upgrades. This could be translated into meaning that unless properly trained, a pilot with experience in the MiG-23MLD, accustomed to certain maneuvers, could find himself or herself in trouble flying an earlier version.	
234.	Adequate Annual Program Letter	Verify the applicant's annual program letter contains sufficient detail and is consistent with applicable regulations and policies. (Many applicants/operators submit inadequate and vague program letters or fail to submit them on an annual basis.) Also verify the proposed activities (for example, an air show at a particular airport) are consistent with the applicable operating limitations (for example, avoiding populated areas) and do not pose a safety hazard, such as the runway being too short. There may be a need to review the proposed airports to be used.	

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235.	Additional Program Letter Guidance	Ensure program letters accompanying an application for an experimental airworthiness certificate meet the requirements of § 21.193. The letter must be detailed enough to permit the FAA to prescribe the conditions and limitations necessary to ensure safe operation of the aircraft. The letter must include— 1. The purpose for which the aircraft is to be used (such as R&D, crew training, or exhibition). 2. The purpose of the experiment. The letter must describe the purpose of the experiment and the aircraft configuration or modifications, and outline the program objectives. 3. The estimated number of flights or total flight hours required for the experiment and over what period of time (for example, days, or months). 4. The areas over which the experiment will be conducted. A written description or annotated map is acceptable. Specifically describe the area. Describing the operating area as "the 48 states," is not acceptable. The FAA may establish boundaries of the flight test area, including takeoff, departure, and landing approach routing to minimize hazards to persons, property, and other air traffic. However, it is the responsibility of the operator to ensure safe flight of the aircraft. 5. Unless converted from a type certificated aircraft, three-view drawings or three-view dimensioned photographs of the aircraft. 6. Any pertinent information found necessary by the FAA to safeguard the general public. The letter must also include any exemptions that may apply to the aircraft, such as non-standard markings or using an experimental aircraft for hire. 7. If using the aircraft for multiple purposes or roles, (1) documentation of all operations for each purpose, (2) a description of any configuration changes that will occur between each purpose to include adding or removing external stores and enabling or disabling systems, and (3) a separate section for each purpose. For example, an aircraft could have an experimental airworthiness certificate for the purposes of R&D and exhibition. The same aircraft may also conduct military, State, or PAO. In this example, the program letter must describe all three roles with the same level of detail. While the airworthiness certificate is not in effect, nor can the FAA prescribe limitations for PAO, the FAA cannot determine the appropriate certification for the aircraft without knowledge of how the aircraft is used. **SAMPLE— Research and Development / Exhibition – Applicant Program Letter for a Special Airworthiness Certificate** • Registered Owner (as shown on Certificate of Aircraft registration): N*AME: Brand X Support Services, Inc., ADDRESS: 123 Airport Street, Any Town, USA 00010.* • Aircraft Description: Registration Marks: i.e., *N12345,* Aircraft Yr. Mfg.: *1965,* Aircraft Serial No. 452*,* and Aircraft Model Designation: North American F-100. <u>R&D</u> • Describe program purpose for which the aircraft is to be used (14 CFR 21.193(d) (1)), i.e., *R&D providing chase for Major Airplane Manufacturer for certification testing of their next business jet. Aircraft Certification Office X is the project office. The assigned project number is ACOXzzz;* • Provide the following information as it pertains to your Program Letter (a) List estimated flight hours required for program, i.e. 75 hours, (b) List estimated number of flights required for program, number of flights, i.e. *50,* (d) List estimated duration for programs (14 CFR § 21.193(d)(2)), i.e. *150 days;* • Describe the areas over which the flights are to be conducted, and address of base operation (14 CFR 21.193(d) (3)), i.e., *the flights will take place within 150 nm of airport KAAA, excluding the airspace over City-X. The maximum altitude FL 240240. The base of operations is Major Airplane Manufacturer Hangar, 12345 Tower Drive, City, etc.;* • Describe the aircraft configuration (attach three-view drawings or three-view dimensioned photographs of the aircraft (14 CFR 21.193(d) (4) and include a description of how the configuration is different from the other purposes listed). *See attached.* <u>Exhibition</u> • Describe program purpose for which the aircraft is to be used (14 CFR 21.193(d)(1)) such as e*xhibition at the following events over the next 8 months, i.e., AirVenture, August 1, 2013;* • Provide the following information as it pertains to your Program Letter (a) list estimated flight hours required for program, i.e., *13 hours exhibition, including the flights to and from the events. 10 hours for crew training; (*b) list estimated number of flights required for program, and (c) list estimated duration for programs (14 CFR § 21.193(d)(2)), i.e. *8 months;* • Describe the areas over which the flights are to be conducted, and address of base operation (14 CFR 21.193(d)(3)), i.e. c*rew training flights will take place within 125 nautical miles of Any Town, USA airport with a maximum altitude of 10,000 feet. The base of operations is the address listed above;* • Describe the aircraft configuration (attach three-view drawings or three-view dimensioned photographs of the aircraft (14 CFR 21.193(d) (4) and include a description of how the configuration is different from the other purposes listed). *See attached;* • Date, Name and Title (Print or Type), and Signature.	

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236.	Flight Manual Warnings, Cautions, and Notes	Consider requiring review (before flight) of all flight manual warnings, cautions, and notes. Such a review will greatly enhance safety, especially in those cases where the PIC does not maintain a high level of proficiency in the aircraft. This includes a detailed understanding of the warning and annunciator panel, which must be in English.	
237.	Operating Limitations	Ensure the PIC operates the aircraft as specified in the section discussing operating limitations, in addition to the FAA-approved operating limitations.	
238.	Safety Supplements	Verify the applicant/operator has incorporated the applicable safety supplements (or Soviet equivalent) into operational guidance as appropriate.	
239.	Foreign Aircraft Particularities and Restrictions	Verify whether the aircraft includes aircraft-specific restrictions if it is of foreign origin. If those restrictions exist, the operator must understand those restrictions before flight, especially any post-restoration flight.	
240.	Maintenance and Line Support	Verify the aircraft is operated with qualified crew chief (with adequate former military experience and MiG-23 training), especially during preflight and post-flight inspections as well as assisting the PIC during startup and shutdown procedures. The following example of an Indian Air Force MiG-27ML illustrates the need for adequate support: “On September 9, 2009, the [engine mechanic] was detailed to carry out [a first flight inspection] on a MiG-27 ML aircraft. During [the inspection, he] observed a bend on corner tip of the first stage compressor blade. Normally, the first stage blades are repaired after the removal of the engine at the overhaul agency. [The mechanic] displayed dedication to duty, a keen sense of observation, and a high degree of professionalism in averting an accident / incident.” http://www.indianairforce.nic.in/fsmagazines/Feb10.pdf.	
241.	Ejection Seat System PIC Training	Require adequate ejection seat training for the PIC and crew, if applicable, for the type of seat installed. Experience with U.S. seats (that is, ACES) or British ejection seats (Martin-Baker) is not sufficient. The PIC must also be able to ensure any additional occupant is fully trained on ejection procedures and alternate methods of escape. Evidence shows the safety record of attempted ejections in civilian former military aircraft is very poor, typically indicating inadequate training leading to ejections outside of the envelope. The ejection envelope is a set of defined physical parameters within which an ejection may be successfully executed.	
242.	Ejection Seat System Ground Safety	Verify the safety of ejection seats on the ground. Verify ejection seats cannot be accidentally fired, including prohibiting untrained personnel from sitting on the seats. As NAVAIR states, “the public shall be denied access to the interior of all aircraft employing ejection seats or other installed pyrotechnic devices that could cause injury.” In addition, operators should provide security during the exhibition of the aircraft to prevent inadvertent activation of the ejection system from inside or outside the aircraft by spectators or onlookers. The PIC on a recent jet warbird operation noted: “Recently we had a case where a guest in the back jettisoned the rear canopy on the ground at the parking position while trying to lock the canopy with the lever on the R/H side… The canopy went straight up for 6 m (20 ft.) and fell back on the ground, right in front of the left wing leading edge next to the rear cockpit (fortunately not straight back on the cockpit to punish the guy).” Note: Any ejection seat training must include survival and post-bailout procedures, based either on U.S. Navy or USAF training (or NATO), as appropriate for the equipment being used. Note: As a result of accidents, DOD policy prohibits the public from sitting on armed ejection seats.	
243.	Ejection Seat System Safety Pins	Require the PIC to carry the aircraft’s escape system safety pins on all flights and high-speed taxi tests. As a recommendation stemming from a fatal accident, the U.K. CAA may require “operators of civil registered aircraft fitted with live ejection seats to carry the aircraft’s escape systems safety pins (a) on all flights and high-speed taxi tests (b) in a position where they are likely to be found and identified without assistance from the aircraft’s flight or ground crews.”	
244.	Parachutes (Live Ejection Seat)	As part of the ejection seat system, the parachute (must an approved parachute for that ejection seat system) must be maintained and inspected in accordance with the manufacturer’s (or applicable NATO) procedures and standards. The parachute must be rated for the particular ejection seat being used. Many MiG-21 accidents have been fatal because of parachute malfunctions.	
245.	Parachute (De-Activated Ejection Seat)	Comply with § 91.307, Parachutes and Parachuting. This regulation includes parachute requirements (1) that the parachute be of an approved type and packed by a certificated and appropriately rated parachute rigger, and (2) if of a military type, that the parachute be identified by an NAF, AAF, or AN drawing number, an AAF order number, or any other military designation or specification number. Concerning parachutes, track parachute log books along with serial number, dates of manufacture and service life limits. The parachute must be packed, maintained, or altered by a person who holds an appropriate and current parachute rigger certificate. The certificate is issued under Title 14 of the Code of Federal Regulations (14 CFR) part 65, subpart F. Note: Some operators deactivate the ejections seat but continue to carry the parachute. Such practices need to be properly documented and adequate training and procedures instituted.	
246.	Pyrotechnics and Pylon Ejectors	Except for those that are part of the ejection seat system, the installation, and use of any pyrotechnics, including those installed as part of pylons and ejector units in external stores are prohibited. Prohibit explosive pylon charges (ejectors). The related pylon/ejector assemblies cannot be functional.	
247.	Engine Operating Limits	Adhere to all engine limitations in the applicable flight manuals.	

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248.	Spool Down Time	Verify the AIP incorporates action(s) following a change in the spool down time of the engine(s) after shutdown. This is critical as it could be an indicator of an upcoming problem with the engine.	
249.	External Stores (General)	Prohibit the installation of external stores that were not approved by the military service. No homemade or improvised external stores or any kind are permitted. No means of jettison the external stores may be functional and actual jettison must be mechanically prevented. Under FAA Order 8130.2, only aircraft certificated for the purpose of R&D may be eligible to operate with functional jettisonable external fuel tanks or stores, but the safety of people and property on the ground still has to be addressed. As the NTSB stated in 2012 following the fatal accident of a high-performance experimental aircraft, “the fine line between observing risk and being impacted by the consequences when something goes wrong was crossed.” In many cases, the pilots may understand the risks they assumed, but the spectators’ presumed safety has not been assessed and addressed. See *Pylon Ejectors and Explosive Release Units* below.	
250.	External Fuel Tanks	Verify the type, condition, installation, and removal of external fuel tanks meet the applicable requirements, i.e., NATO. Only external tanks cleared for use by the applicable military service (i.e., NATO, Indian AF) may be used on the aircraft. The MiG-23 can carry three drop tanks, two wing tanks and one centerline tank, with a total fuel capacity of 2,400 liters. Ensure familiarity with the fuel consumption sequence when external tanks are used in the automatic fuel transfer process. External fuel tank installation is not a simple task nor should they be “homemade” proven by a simple flight test. Drop tank clearance relies on elaborate engineering and flight test processes that can be compared to a simple flight to show that they hold in Phase I. There are serious issues with air loads, fittings, G limitations, flutter, limitations on the amount that can be used, take-off, and landing performance, W&B issues, and fuel sloshing, and so on. The AIP needs to address their inspection and maintenance. The safety issues with these systems is not covered by § 91.15 Dropping objects. There is a distinction between removable and jettisonable tank. A MiG operator in the US explains that “we have removable drop tanks on our…MiG… We sometimes fly to airshows with the tanks on, remove the tanks for the show, and then put them back on for the flight home. Removable vs. droppable.” http://eaaforums.org/showthread.php?2644-Need-quick-answer-Drop-tanks-on-a-warbird/page2. Finally, there should not be any modifications to the drop tanks, except when to prevent jettisoning. Note: The drop tanks would typically have data plates.	

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251.	Dropping or Releasing Ordnance	Prohibit the dropping or release of ordnance, including training ordnance. Although Part 91 and FAA Order 8130.2 provide some references to dropping objects (i.e., 91.15 and “droppable” in R&D certificates in 8130.2), the fact is that neither contemplated (1) ordnance release, and (2) considered the many dangers of such activities. Part 91 and the Order were designed to address civil purposes, not combat testing, and training. From a practical standpoint, under 91.319 and related guidance, including SMS, the issue is one of (1) identifying the risks, and (2) mitigating them within the valid civil purposes. In some cases, some risks cannot be mitigated, and that needs to be recognized. It is inadequate to consider issuing a civil airworthiness certificate to permit ordinance and other loads to be releasable (as a matter of fact, that is “drop whatever you want as you wish…”) solely based on (1) a review of 91.15 and 8130.2 guidance, (2) and the claim that the “aircraft used to do that in the military…” argument. There is much more to such activities. To illustrate the dangers of such activities, the following listing provides some, but not all, of the issues/dangers/risks that have to be addresses or mitigated (not necessarily in a priority order): 1. Liability; 2. 49 U.S.C. § 47107(a) concerning restricting airport access (federally-obligated airport) on the grounds of safety; 3. Adherence to a significant applicable guidance and safety requirements; 4. Storage safety; 5. Handling and installation safety (procedures); 6. Handling and installation (personal training, i.e., Aviation Ordnance men rating); For example, personnel directly involved in ordnance handling must be qualified and/or certified according to the Navy's current qualification/certification programs; 7. Ramp safety; 8. Safety of any signal cartridge; 9. Fuzing safety; 10. Safety or any propellants; 11. HAZMAT considerations; 12. Mechanical v. pyrotechnical release; 13. Only service (i.e., cleared ordnance, configurations, and parameters); 14. Weapon (system) specific separation testing and associated limitations to address air loads, fittings, G limitations, flutter, limitations on the amount that can be used, take-off, and landing performance, W&B issues. 15. Impact on aircraft’s structure; 16. Impact on aircrafts’ electrical system; 17. Safety of people and property on the ground; 18. Flight route safety and ATC coordination; 19. Safe altitudes; 20. Range safety; 21. Emergency and inadvertent release; In summary, the FAA is not in a position to assume responsibility for handling the issues above and incorporate them in the civil airworthiness certification process.	
252.	Pylon Ejectors and Explosive Release Units	Prohibit explosive pylon charges (ejectors). The related pylon/ejector assemblies, including the pylon ejector mechanism cannot be functional. See External Stores (General) above.	
253.	External Tank Failures	The operating limitations (as well as SOPs) should incorporate the specific drop tank limitations related to (1) takeoff and landing performance, (2) G limits, (3) airspeed, and (4) fuel in the tanks.	
254.	Asymmetric Wing Mounted Stores	Prohibit asymmetric wing mounted equipment regardless of the applicable manuals.	
255.	Emergency Stores Release Handle (ESRH)	Disable the ESRH, or Soviet equivalent.	
256.	Master Armament Switch	Disable and disconnect the master armament switch from all systems. Weapon-related buttons (bomb/rocket button, trigger) on the control stick grip and panels must also be disabled and disconnected from all systems.	
257.	Weapons Functions	Weapon functions that exist in several of the systems, particularly in upgraded A-4s, have to be disabled. These include functions in the HUD, control stick, and HOTAS systems.	

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258.	Restrict Acrobatics	Prohibit all acrobatics maneuvers, including airshow demonstrations. No low altitude “maneuvering,” including horizontal maneuvers should be permitted or wavers provided. The risk associated with poor lateral control at high AOA, possibility of structural damage, insufficient pilot training and familiarity turn acrobatic maneuvers, at any altitude, into unnecessary risks. It is highly unlikely that a MiG-23 PIC will maintain sufficient proficiency and currency in the aircraft for such maneuvers. There are documented issues that the USAF “Red Eagles” squadron encountered with the MiG-23 inadvertently entering spins during various Air Combat Maneuvering (ACM) engagements with dissimilar aircraft. In USAF service, a pilot dead-sticked a MiG-23 to a landing after an aircraft handling sortie by pulling too hard on the stick with wings swept back and going out of control, thereby entering a spin. The spin caused warping of the compressor blades to tear out the louvers, which went into the turbine section, causing these blades to break off and start a fire. The engine casing was the weak link during out-of-control maneuvers. The MiG-23 was never designed for high-G flying. Titanium is used extensively in the compressor section. The first six stages, both rotors and starters, are titanium, while the rest of the compressor blades are steel. The compressor case is divided into six sections, the first four of which cover the low-pressure compressor and are made of titanium. The remainder of the case is steel. Eleven inspection ports are located along the compressor case. Using these ports, a complete borescope inspection of the compressor is allowed without removing the engine from the airframe. The following account by a US civil pilot introduced to the MiG-23UB adds some detail to the aircraft “lack of maneuverability” which can be a trap at low altitude: “…once again punctuated the MiG-23's restricted field of view as I threw my head back in search of an outside horizon reference. I felt a similar restriction during the slice back maneuver (a hard, nose-low reversal entered at 135° of bank for a 180° heading change), which I entered in military power at around 430 knots, more or less the aircraft's corner velocity (the lowest speed at which it can attain its maximum allowable g), with the wings set at 45°. With the bank angle established, I initiated an immediate pull into the light buffet, feeling for the aircraft's maximum coefficient of lift. I peaked out at 5.5 g in this combat turn, the highest g-load registered during my flight. The aircraft lost a lot of altitude in the reversal, indicating yet again that it is a generation behind the MiG-29 and Su-27. My rolls and unloaded slow roll, all to the left, indicated a slow response rate compared to other fighters which I have flown…it took pronounced lateral stick displacement to achieve the roll rate I was seeking. Pitch-trim response during airspeed transitions was also notably slower than I am accustomed to.” Lambeth, 1994. Note: The MiG-23 does not have ailerons; it has spoilers. However, lateral appears to be more effective suing differential stabilizer.	
259.	Mach Meter and Airspeed Calibration	Require the installation and calibration of an approved Mach meter/airspeed indicator and verify the PIC makes the proper Mach determination before flight, if necessary. This may not be a simple task. Case in point, a US MiG-23 restorer advertised the fact that the organization is “looking for F-4 or F-16 airspeed indicators to place in MiG-23 that we are presently restoring. Any leads would be greatly appreciated…” http://www.classicjets.org/forum/. This “approach” could raise serious technical issues that have to be properly addressed.	
260.	Changes in Approved External Aircraft Configuration	Any change in external loading for the MiG-23 (e.g., a change in a pylon, rack, or external store) from configurations previously approved by the manufacturer, NATO or some operators (Soviet Air Force, Indian Air Force) should be justified via analyses, test, and data.	
261.	Accelerometer	Ensure the aircraft’s accelerometer is functional. This instrument is critical to remain within the required G limitation of the aircraft.	
262.	V_{ne} of 0.9 Mach	Restrict airspeed to 0.9 Mach. This provides a good safety margin and could be addressed in the operating limitations, the AFM, and related SOPs.	
263.	Swing Wing Settings and Limitations	In Soviet service, the MiG-23 suffered from heavy attrition, often due to wing-sweep mechanism failures and deviation from limitations. Within the provisions of the applicable flight manual, i.e., *MiG-23UB Pilot’s Operating Instructions, Version 5 – Flight Performance*, recommend that the operation of the aircraft be restricted to the first two setting of wing swept, namely 16° (take-off, landing, long range flight, low speed flight) and 45° (mostly ACM in the high subsonic range). The third setting, 72°, is used at high supersonic speeds (not permitted under civil use), but may have dangerous characteristics if used outside its design and operational envelope. Lack of familiarity and currency in the aircraft can exacerbate this concern. In fact, a 1990 accident involving a Hungarian Air Force MiG-23 at an airshow was caused, in part, to the misuse of the setting during fly by. A witness to the event noted: “I encountered the swing-wing-Flogger quite frequently, when I was travelling from Vienna to the Eastern-European airfields in the 1990s. A negative highlight of course was to witness the horrible crash at Papa in September 1990. Looking through the (old Minolta) tele-lens in following his display, I was already wondering why he left the wings set fully swept when downward turning-in relatively low from the right. But only when I saw the trees behind him I noticed his fatal error. Pressing the shutter three times (it was the age of slides) I captured that particular image. When taking the camera from the eye, the Flogger '04' was already in an upward attitude (after hitting the ground), but burning like hell. When it exploded in mid-air nobody was sure on what side of the display line the wreck would fall and so we were all running backwards. But it came down in straight-line of the general axis, about 50 ft. from the runway...“Georg Mader. This recommendation may have the added benefit of minimizing use and strain on the swept wing system itself, a known issue with the aircraft. A civil MiG-23 pilot adds that a “as the wings sweep to 72° the roll rate diminishes, due mainly to the disconnection of spoilers at any but 16 degrees. There is not much forgiveness especially when operating at the 72° sweep.” http://www.warbirdsofdelaware.com/Airplanes/MiG23/MiG23PilotReport. On the issue of the MiG-23 swing-wing, a US civil pilot noted: “Situated on the left side panel, immediately behind the throttle, are three flap position-select buttons marked, respectively, take-off, cruise and land. Directly inboard of the throttle is a three-position handle to fix the variable-geometry wings at 16°, 45° or 72° of sweep. The 16° position is selected for take-off and landing, with the 45° position used for most routine maneuvering. The full-aft position of 72° is only employed for high-speed flight. It requires a minimum airspeed of 325 knots (600 km/h).” Lambeth, 1994.	

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264.	Phase I Flight Testing	Recommend, at a minimum, all flight tests and flight test protocol(s) follow the intent and scope of acceptable USAF/U.S. Navy functionality test procedures. The aircraft needs detailed Phase I flight testing for a minimum of 10 hours. Returning a high-performance aircraft to flight status after restoration cannot be accomplished by a few hours of "flying around." Safe operations also require a demonstrated level of reliability.	
265.	Post-Maintenance Check Flights	Recommend post-maintenance flight checks be incorporated in the maintenance and operation of the aircraft and, in addition, TO 1-1-300, Maintenance Operational Checks and Flight Checks, dated June 15, 2012, be used as a reference when appropriate.	
266.	Flight Over Populated Areas	Prohibit flights over populated areas, including takeoffs and landings. Prohibit all flights over populated areas, including takeoffs and landings. The consequences of a MiG-23 accident in a populated area would be devastating. As an example, on March 1, 1990, following a mechanical failure and the pilots' ejection, an Indian Air Force MiG-27 killed 50 civilians on the ground. Strict operating areas must be established for the MiG-23. While the experimental category may allow a reduced level of safety for the aircraft when compared to a standard category aircraft, an equivalent level of safety for the public must be maintained. In all instances, there must be adequate and detailed egress and ingress routes in and out of all airports that are used to avoid flights over and near populated areas. Recommend the general avoidance of populated areas be accomplished by keeping the aircraft a certain distance away from those areas (that is, 2 nautical miles), not just "clear underneath" and not to direct energy at those areas such as keeping the populated areas behind the forward 180° quadrant in relation to the aircraft's flight path. This requires rigorous flight planning. To address this, any airport used must be evaluated as part of the program letter. As the NTSB stated in 2012 following the fatal accident of a high-performance experimental aircraft, "the fine line between observing risk and being impacted by the consequences when something goes wrong was crossed." Specifically tailor geographic proficiency areas, not just in terms of distance, but also taking into account specific populated areas. It is necessary to review egress and ingress routes in detail. Rigorous flight planning is needed from the PIC. Simply flying a route that is not "directly" over populated areas but that near such areas may not provide an adequate level of safety. Ejecting from an aircraft that is not directly over a populated area is not enough to prevent the aircraft from impacting people and property on the ground a short distance away. Case in point, in many military aircraft like the MiG-23, the loss of hydraulic power (not uncommon) can lead to a severe if not a total loss of control. Therefore, the pilot becomes unable to further direct the aircraft and the aircraft "will choose its own impact point." If the loss of control occurs at a certain altitude, it is actuality possible (if not highly likely) that the probability of the aircraft impacting an area away from the intended rather than directly underneath the flight path is actually greater. Thus, it is important to remember that the applicant that the PIC is responsible for complying with the operating limitation restricting flights over populated areas. The PIC must be aware of the areas above which the flight is taking place and coordinate with ATC accordingly. Regardless, the very nature of this type of aircraft dictates that the operator must be the one to find a way to avoid the populated areas, and if in some cases, their overfly cannot be avoided, then it is incumbent upon the operator, as per the limitations, to find an alternate airport from which operate of transit in and out of. A news release concerning a 2003 MiG-23 crash illustrates the issue: "At least six people were killed when a MIG-23 fighter jet of the Indian Air Force crashed Friday into a residential area in northern India. Several people, including children, were feared buried under the debris of the three houses that were hit by the air force plane in Mullanpur Dakha village in Punjab state. The plane wreckage set on fire the neighboring buildings, and scores of fire fighters were trying to contain the blaze. The pilot of the ill-fated plane ejected safely within seconds of taking off from the Halwara Air Force base. Witnesses say they saw a rolling flame ball falling from the skies. http://www.upi.com/Business_News/Security-Industry/2003/04/04/MIG-23-crash-kills-six-civilians-in-India/UPI-67911049486986/#ixzz2IWAXszES."	
267.	Controlled Bailout Area	If operational procedures require establishing a controlled bailout area, ensure it (1) does not endanger people or property on the ground in any way, (2) follows established USAF/NAVAIR procedures, and (3) addresses the possibility of erratic flight paths after ejections. Refer to *Flight Over Populated Areas* above. The following is an example of a MiG-23 erratic flight path after an ejection: "The incident started as a routine training flight. Colonel Nikolai Skuridin, the pilot, departed from the Soviet Bagicz Airbase near Kołobrzeg, Poland. During takeoff, the afterburner failed and the engine began losing power. At an altitude of 150 meters and descending, the pilot assumed he had a complete engine failure and ejected without incident. However, the engine had not failed completely, and the aircraft remained airborne, flying on autopilot in a westerly direction. The unmanned aircraft left Polish airspace, crossing into the airspace of East Germany and then West Germany, where it was intercepted by a pair of U.S. Air Force F-15s of the 32nd Tactical Fighter Squadron, of the U.S. Air Forces Europe, stationed at Soesterberg Air Base in the Netherlands. As the MiG-23 crossed into Dutch airspace the F-15 pilots reported the plane having no pilot *'There is definitely no pilot in the plane'* and continued the intercept into Belgian airspace. The escorting F-15s were instructed to down the plane over the North Sea. As the MiG ran out of fuel, it started a slow turn to the south. The French Air Force put armed Mirage fighters on readiness in case the MiG approached French territory. However, after flying over 560 miles the MiG crashed into a house, killing a Belgian teenager." Refer to http://en.wikipedia.org/wiki/1989_Belgian_MiG-23_crash#cite_note-2#cite_note-2.	
268.	G Limitations	Ensure there are conservative G limits. Recommend a 2.5G maximum. Many of these aircraft have structural problems dictating this prudent approach. If higher limits are proposed, the applicant must provide data to support that request. Without it, the FAA must ensure an adequate level of safety, and this can only be accomplished by being very conservative due to the aircraft's history, age, and operations use. There is no justification to take the aircraft anywhere near its original limitations. The fact that the aircraft could be G loaded does not mean such performance should be attempted or is inherently safe. This is especially true given the aircraft's age and historical use. Maximum G limits should be established below design specifications based on the age and condition of the airframe. G limitations are needed to help mitigate many concerns, including structural concerns (wing box area), the potential for loss of control, and compressor stalls.	

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269.	AOA System Limitations	Ensure the AOA system is functional and properly maintained, inspected, and calibrated per the applicable guidance. If not, the aircraft is not airworthy and cannot be flown. In addition, recommend that a maximum AOA be considered as part of the aircraft's operating limitations, possibly 30°. A Soviet MiG-23 pilot put it simply, and noted that "flying a MiG-23 at a high angle of attack was a sure way to enter an often fatal flat spin." Zuyev, 1992. See Minimum Display Altitude and Limitations below.	
270.	Visual Meteorological Condition (VMC) and Instrument Flight Rules (IFR) Operations	Allow day VMC operations only. Many MiG-23 accidents were caused by spatial disorientation. Note: The MiG-23 was not an easy aircraft to operate at night or in low visibility. Known icing needs to be restricted as well. One of the main issues is the unnatural representations by several of the cockpit instruments. See *Cockpit Familiarization* below. Unless a high-level of proficiency and currency in the aircraft in instrument conditions and at night, it is unsafe to permit such operations.	
271.	Carrying of Passengers, § 91.319(a)(2)	Prohibit the carrying of passengers at all times. No rides. Legitimate flight training is permitted only in accordance with an FAA-issued letter of deviation authority (LODA).	
272.	Commercial Human Spaceflight Crew Training and Support	This airworthiness certificate is not valid for commercial human spaceflight crew training and support activities. A number of commercial, governmental, academic, and non-profit organizations may want to provide commercial human spaceflight crew training and support. These training and support services range from teaching and simulating the physiological effects of working in the microgravity environment to high-fidelity simulation of spacecraft flight characteristics. However, the practical application of several of these functions in a MIG-23 aircraft may include many safety issues and risks factors that may not have been identified or discussed in this document. Note: The Federal Aviation Administration, Office of Commercial Space Transportation, licenses and regulates U.S. commercial space launch and reentry activity as well as the operation of nonfederal launch and reentry sites as authorized by Executive Order 12465 and Title 49 United States Code, Subtitle IX, Chapter 701 (formerly the Commercial Space Launch Act). The Office's mission is to ensure public health and safety and the safety of property while protecting the national security and foreign policy interests of the United States during commercial launch and reentry operations. In addition, the Office is directed to encourage, promote, and facilitate commercial space launches and reentries. Additional information concerning commercial space transportation can be found at http://ast.faa.gov.	
273.	Second Occupant Training and Limitations	Implement adequate training requirements and testing procedures if a person is carried on the back seat [refer to *Carrying of Passengers, § 91.319(a) (2)* above for limitations under § 91.319(a) (2)] to allow the performance of that crew's position responsibilities per the applicable Crew Duties section of the Flight Manual. This training should not be a simple checkout, but rather a structured training program (for example, ground school on aircraft systems, emergency and abnormal procedures, "off-limits" equipment and switches, and actual cockpit training). The back seat qualification should also include (1) ground egress training (FAA-approved ejection seat training), (2) ejection seat and survival equipment training, (3) abnormal/emergency procedures, and (4) normal procedures. In addition to any aircraft-specific (that is, systems and related documentation) training, it is recommended that the *Naval Aviation Survival Training Program* (Non-aircrew NASTP Training) or/and *the United States Air Force Aerospace Physiology Program* (AFI 1 I-403, Aerospace Physiological Training Program) be used in developing these programs. In addition, passenger physiological and high-altitude training should be implemented for all operations above 18,000 ft. This issue can be addressed as part of the operating limitations by requiring the right seat training and incorporating the adequate reference (name) of the operator's training program. The following 1994 account by a US civil pilot who flew in a Soviet AF MiG-23UB provides insight into several of the issues facing someone unfamiliar with the aircraft: "A Mikoyan ground technician was on hand to help me strap in and set up some switches in the cockpit, as indicated by the pre-start checklist. Several switches, relating to navigation, communications, and engine start, are not duplicated in the aft cockpit. The KM-1 rocket-powered ejection seat is a generation older than the now-standard K-36D seat. The headrest, ejection handles and harness arrangement all appears to be similar, however. An important difference is that the MiG-23 seat had squeeze-and-pull ejection handles, whereas those on the K-36D are single-motion. Gorbunov indicated that the handles require about a 20 kg pull to fire the seat. The MiG-23UB has a sequenced ejection capability, which was selected to aft-cockpit control for our flight. That meant that Gorbunov could command my ejection in the remote chance that we experienced an emergency requiring immediate abandonment of the aircraft. As in the MiG-29, the egress system does not feature leg-restraining garters, but has cables around the rudder wells to pull the legs into the seat during ejection, to prevent flailing. The seat also has an integrated harness which comes together at a center connection point. The emergency canopy-jettison handle is mounted on the right sidewall just below the canopy sill. The handle lay flat in the stowed position, with initiation executed by pulling a spring-loaded handle out and down. Like other Soviet fighters of its generation, the MiG-23 cockpit is painted a deep turquoise. The throttle moves along a horizontal bar mounted on the left sidewall. It features VHF radio-transmit and inter-cockpit-communication (ICS) buttons, as well as a speed-brake switch. The aircraft lacks a "hot-mike" arrangement, which meant that I had to depress the ICS button whenever I wanted to talk to Gorbunov. We maintained a constant low-key exchange in Russian almost from engine start to shutdown. " Flying the Flogger, 1994.	
274.	Stall and Spins	Prohibit intentional stall and spins. As a MiG-23 pilot notes "there is no practicing stalls in this aircraft as it can under many conditions become unrecoverable from a spin, so avoidance is the key." http://www.warbirdsofdelaware.com/Airplanes/MiG23/MiG23PilotReport/tabid/87/Default.aspx.	
275.	Maximum Altitude	Prohibit operations above FL 410. Operations above this altitude are too risky to be mitigated under civil use and without specific training, equipment (i.e., approved Soviet high-altitude suit and equipment, such as the VKK-6M, maintained as per the proper requirements and technical data), inspections, and strict operational procedures. The aircraft's pressurization system, its age, condition, and maintenance are safety concerns. . Note: At heights above 50,000 feet, even with 100% oxygen, a person will quickly become hypoxic, because the ambient pressure is so low that the lungs will not absorb the oxygen. It is at this altitude that a pressurized flight suit must be worn. Any altitude above 50,000 ft. is labeled as "space equivalent zone." Also see *High-Altitude Training* below.	

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276.	High-Altitude Training	Recommend the PIC complete an FAA-approved physiological training course (for example, altitude chamber). Refer to FAA Civil Aerospace Medical Institute (CAMI) Physiology and Survival Training website for additional information.	
277.	Pressure Suit Training	If pressure suits are used, require pressure suit training as per the applicable USAF guidance. This includes original pressure suit training and refresher training. Original training is a one-time requirement provided upon initial assembly and fitting of the pressure suit assembly. Refresher pressure suit training is required every 5 years for those who have undergone original pressure suit training. The reference is *Aerospace Physiological Training Program, AFI 11-403*, November 30, 2012.	
278.	Minimum Equipment for Flight	Ask the applicant to specify minimum equipment for flight per applicable USAF guidance, and develop such a list consistent with the applicable requirements (that is, USAF, NAVAIR, or NATO) and § 91.213. These documents list the minimum essential systems and subsystems that must work on an aircraft for a specified mission.	
279.	Post-Flight and Last Chance Check Procedures	Require the establishment of post-flight and last chance inspections per the applicable guidance (that is, USAF or NATO). Note: Last chance checks may include coordination with the airport and ATC for activity in the movement areas.	
280.	Minimum Runway Length	Ensure a minimum runway length of 8,000 ft., with no exceptions. In addition, ensure the PIC verifies, using the appropriate aircraft performance charts (Performance Supplement), sufficient runway length is available considering field elevation and atmospheric conditions. To add a margin of safety, use the following: <u>For Takeoff</u> • No person may initiate an airplane takeoff unless it is possible to stop the airplane safely on the runway, as shown by the accelerate-stop distance data, and to clear all obstacles by at least 50 ft. vertically (as shown by the takeoff path data) or 200 ft. horizontally within the airport boundaries and 300 ft. horizontally beyond the boundaries, without banking before reaching a height of 50 ft. (as shown by the takeoff path data) and after that without banking more than 15 degrees. • In applying this section, corrections must be made for any runway gradient. To allow for wind effect, takeoff data based on still air may be corrected by taking into account not more than 50 percent of any reported headwind component and not less than 150 percent of any reported tailwind component. <u>For Landing</u> • No person may initiate an airplane takeoff unless the airplane weight on arrival, allowing for normal consumption of fuel and oil in flight (in accordance with the landing distance in the AFM for the elevation of the destination airport and the wind conditions expected there at the time of landing), would allow a full stop landing at the intended destination airport within 60 percent of the effective length of each runway described below from a point 50 ft. above the intersection of the obstruction clearance plane and the runway. For the purpose of determining the allowable landing weight at the destination airport, the following is assumed: o The airplane is landed on the most favorable runway and in the most favorable direction, in still air. o The airplane is landed on the most suitable runway considering the probable wind velocity and direction and the ground handling characteristics of that airplane, and considering other conditions such as landing aids and terrain. Like other aircraft, the MiG-23 has a high number of overruns as part of its operational history, both on landing and as a result of aborted takeoffs. The aircraft's difficult taxiing performance and high rate of engine failure dictate a safety margin in terms of takeoff and landing requirements. See *Rejected Takeoff* below.	
281.	Runway Considerations	Consider accelerate/stop distances, balanced field length, and critical field length in determining acceptable runway use per CJAA guidance. To enhance operations, it is recommended takeoff procedures similar to the USAF minimum acceleration check speed (using a ground reference during the takeoff run to check for a pre-calculated speed) is adopted.	
282.	Runway Damage	Ensure the operation of the aircraft avoids damaging the runway and related infrastructure, namely due to the use of the afterburner. This was an issue in the IAF, and with other operators. For example, because of their gear-configuration, the older MiG-23 MF and the two-seater MiG-23UB literally sit on their 'behinds.' It is documented that "the Czech and Hungarian air forces discovered was the problem that the strong plume of the afterburner and the resulting takeoff-angles were destroying the surface of the runway. Therefore they changed the asphalt-surface of the runways for concrete (at least at Papá, Caslav, and Pardubice). This did not occur in the later ML-version..." Georg Mader.	

Issue #	Issue(s)	Recommended Review, Action(s), and Coordination with Applicant	Notes, Action(s) Taken, and Disposition
283.	Runway Safety Areas (RSA)	Recommend restricting use to airports with appropriate runway safety areas (RSA) and Runway protection Zones (RPZ) to add a margin of safety. A runway safety area (RSA) is defined as the surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of undershoot, overshoot, or excursion from the runway. The RSA is an integral part of the runway environment. RSA dimensions are established in AC 150/5300-13, A*irport Design* and are based on the Airport Reference Code (ARC). The RSA is intended to provide a measure of safety in the event of an aircraft's excursion from the runway by significantly reducing the extent of personal injury and aircraft damage during overruns, undershoots and veer-offs. Refer to FAA AC 150/5300-13, *Airport Design*. FAA Order 5200.8 *Runway Safety Area Program* provides additional insight into the value of RSAs. In addition, where possible, recommend USAF Potential Loss of Aircraft Zone (PLAZ) standards be used as well.	
284.	Engineered Materials Arresting Systems (EMAS)	Recommend that, in conjunction with RSA consideration, runways with EMAS should also be considered. This is important because When it is not practicable to obtain a safety area that meets current standards, consideration should be given to enhancing the safety of the area beyond the runway end with the installation of EMAS. The AC 150/5220-22, *Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns,* pertaining to the installation and use of EMAS, provides details on design to be considered in determining feasibility of this alternative. EMAS uses crushable concrete placed at the end of a runway to stop an aircraft that overruns the runway. The tires of the aircraft sink into the lightweight concrete and the aircraft is decelerated as it rolls through the material.	
285.	Suitable Airport	Ensure all airports to be used are properly vetted in terms of suitability (that is, runway length, RSAs, emergency equipment). Requiring prior coordination with the airport management and fire rescue would not be unreasonable in some cases. If this is contemplated, coordination with the Appropriate FAA Airports District Office (ADO) and FAA's Airports Compliance Division, ACO-100, is required to ensure compliance with the applicable 49 U.S.C. airport access requirements as outlined in FAA Order 5190.6 *FAA Airport Compliance Program*. This order sets forth policies, procedures, interpretation, and the administration of the various federal requirements associated with FAA airport funding, which includes requirements for safe operations and terms and conditions for airport access at federally obligated airports.	
286.	Barrier MA-1, MA-1A, and BAK-15	Recommend that, in conjunction with RSA consideration, runways with EMAS should also be considered. This is important because When it is not practicable to obtain a safety area that meets current standards, consideration should be given to enhancing the safety of the area beyond the runway end with the installation of EMAS. The AC 150/5220-22, *Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns,* pertaining to the installation and use of EMAS, provides details on design to be considered in determining feasibility of this alternative. EMAS uses crushable concrete placed at the end of a runway to stop an aircraft that overruns the runway. The tires of the aircraft sink into the lightweight concrete and the aircraft is decelerated as it rolls through the material. Note: These were and are available, if not required, for MiG-21 operations in the Soviet and Warsaw Pact air forces, but currently at Indian Air Force bases as well.	
287.	Wet Runway	Recommend the applicant/operator restraint from operating the aircraft on any runway that has standing water. The lack of anti-skid is a major safety concern.	
288.	Jet Exhaust Dangers	Establish adequate jet blast safety procedures per the appropriate guidance. If not available, use similar data from equivalent USAF, NAVAIR, or NATO aircraft (weight and engine thrust, and thrust line).	
289.	Servicing and Flight Servicing Certificate	Ensure the applicant verifies ground personnel are trained for operations with an emphasis on the potential for fires during servicing. Prohibit non-trained personnel from servicing the aircraft. Recommend a Flight Servicing Certificate or similar document be used by the ground personnel to attest to the aircraft's condition (that is, critical components such as tires) before each flight to include the status of all servicing (that is, liquid levels, fuel levels, hydraulic fluid, and oxygen). Specific servicing areas may include: oxygen tanks and filler, fuel fillers, engine oil tank, brake control units, batteries, external power receptacles, rain removal system, single-point refueling (needs to be disabled), emergency air bottle and filler, and hydraulic reservoir.	
290.	Ground Support Equipment	Verify all required ground equipment for the MiG-23 is available and in a serviceable condition.	
291.	Aerial Target Towing	Prohibit aerial towing. Notwithstanding the standard language in the FAA Order 8130.2 limitations concerning towing, the aircraft is not to be used for towing targets because such operations pose a danger to property and people on the ground and endanger the aircraft.	
292.	TP-23-1 System	If installed, verify that the TP-23-1 infra-red search and track (IRST) system and its liquid nitrogen cooling system are disabled.	
293.	Klyon-PM (Maple-PM)Laser Range Finder/Designator	If installed, verify that the laser range finder & designator is removed or permanently disabled.	

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294.	Drag Chute Installation and Use	Ensure use of the drag chute for all flights, and verify it is done per the applicable technical guidance. This is an operational requirement for all flights. In addition, the operator needs to ensure adequate and safe handling procedures for the recovery of the drag chute by ground/servicing personnel after use. This is important because it may entail recovery from active movement areas in the airport, requiring coordination with airport personnel and ATC clearance/coordination. However, because drag chute failures in the MiG-23 were very common, no takeoff (abort) or landing distance requirement should be computed taking into account the use of the drag chute. This is necessary to ensure an adequate margin of safety.	
295.	Hot and Pressure Refueling	Prohibit hot and pressure refueling. There are too many dangers with these types of operations. Note: Some MiG-23s have sing-point refueling capability.	
296.	Over-Wing Flare/Chaff Dispenser	If so equipped, this installation must be de-activated. This would also apply to any such installation in other locations, namely on the base of the tail. Specifically, the PKiBP-23 (KDS-23M) chaff/flare dispenser comprised two six-round downward-firing units built-in to the centerline pylon. The BVP-50-60 had chaff/flare dispensers mounted on long slim housings on top of the center fuselage. Each dispenser held sixty (60) 50 mm Lo-43 decoy flares.	
297.	Personal Flight Equipment	Recommend the operator use the adequate personal flight equipment and attire to verify safe operations. This includes a helmet, oxygen mask, fire retardant (Nomex) flight suit, gloves (that is, Nomex or leather), adequate foot gear (that is, boots), and clothing that does not interfere with cockpit systems and flight controls. Operating with a live ejection seat requires a harness. Therefore, recommend only an approved harness compatible with the ejection seat be used. Note: Ensure adequate integration of any non-Soviet equipment.	
298.	ARFF Coordination	Coordinate with Aircraft Rescue and Fire Fighting (ARFF) personnel at any airport of landing. A safety briefing should be provided and include: an ejection seat system overview; making the ejection seat safe, including location and use of safety pins; canopy jettison; fuel system, fuel tanks; intake dangers, engine shut-off throttle; fuel; batteries; flooding the engines; fire access panels and hot exhaust ports; and crew extraction-harness, oxygen, communications, and forcible entry. ARFF personnel should be provided with the relevant sections of the aircraft AFM and other appropriate references like Fire Fighting and Aircraft Crash Rescue, Vol. 3, Air University, Maxwell AFB, 1958. An additional reference is the NATOPS U.S. NAVY Aircraft Firefighting and Rescue Manual, NAVAIR 00-80R-14, dated October 15, 2003. The FAA maintains a series of ACs that provide guidance for Crash Fire Rescue personnel. Refer to AC 5210-17, Programs for Training of Aircraft Rescue and Firefighting. Note: On November 1, 2012, the NTSB issued Safety Recommendation A-12-64 through -67. The NTSB recommends the FAA require the identification of the presence and type of safety devices (such as ejection seats) that contain explosive components on the aircraft. It further stated that that information should be readily available to first responders and accident investigators by displaying it on the FAA's online aircraft registry and that the FAA should issue and distribute a publicly available safety bulletin to all 14 CFR part 139-certificated airports and to representative organizations of off-airport first responders, such as the International Association of Fire Chiefs and the National Fire Protection Association, to (1) inform first responders of the risks posed by the potential presence of all safety devices that contain explosive components (including ejection seats) on an aircraft during accident investigation and recovery, and (2) offer instructions about how to quickly obtain information from the FAA's online aircraft registry regarding the presence of these safety devices that contain explosive components on an aircraft.	
299.	Coordination With Airport	Ensure the applicant provides objective evidence that the airport manager of the airport where the aircraft is based has been notified regarding both the presence of explosive devices in these systems and the planned operation of an experimental aircraft from that airport.	
300.	ATC Coordination	Coordinate with ATC before any operation that may interfere with normal flow of traffic to ensure the requirement to avoid flight over populated areas is complied with. Note: ATC does not have the authority to waive any of the operating limitations or operating rules.	
301.	Class B Airspace	Prohibit operations in Class B airspace unless prior permission and coordination is granted by ATC. Unrestricted operations in Class B airspace are not permitted because of the risks involved in such operations, including, but not limited to: • Congested airspace likely; • 250-knot limit may present difficulties for the aircraft (too slow for safety); • Inadequate airspeed range and compatibility with GA and airline traffic (i.e., sequencing); • High likelihood of densely populated areas;	
302.	Minimum Display Altitude and Limitations	Recommend that any display of the aircraft, such as at airshows, be restricted. Recommend at least 300 feet. Also recommend that during low altitude demonstration or displays, all maneuvering not exceed 2Gs. A maximum AOA of 30° is also recommended. See *AOA System Limitations* above.	
303.	Formation Takeoffs and Landings	Prohibit formation takeoffs and landings. There is no civil use, including display, to justify the risks involved.	

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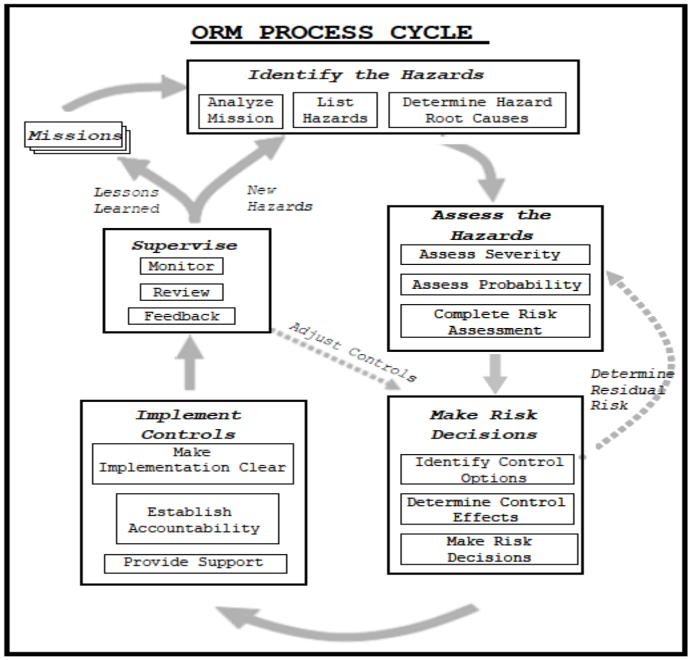
304.	Formation Flight	If permitted, formation flight need to incorporate the following limitations: • 2-ship limit; • Straight and level flight only; • Minimum speed, consistent with the applicable manuals and USAF/NAVAIR procedures; • Minimum separation, i.e., 100 feet; • Annual FAST (Formation and Safety Training) checks to the highest level.	
305.	Aerial Refueling	Some MiG-27s may have been modified for aerial refueling. If such modifications have been made to the aircraft being certificated, prohibit air-refueling, disable the in-flight refueling probe.	
306.	Military/Public Aircraft Operations	Require the operator to obtain a declaration of PAO from the contracting entity or risk civil penalty for operating the aircraft outside the limits of the FAA experimental certificate. Some operators may enter into contracts with the DOD to provide military missions such as air combat maneuvering, target towing, and ECM. Such operations constitute PAO, not civil operations under FAA jurisdiction. Verify the operator understands the differences between PAOs and operations under a civil certificate. For example, the purpose of an airworthiness certificate in the exhibition category is limited to activities listed in § 21.191(d). Note: The following notice, which was issued by AFS-1 in March 2012, needs to be communicated to the applicant: "Any pilot operating a U.S. civil aircraft with an experimental certificate while conducting operations such as air-to-air combat simulations, electronic counter measures, target towing for aerial gunnery, and/or dropping simulated ordinances is operating *contrary* to the limits of the experimental certificate. Any operator offering to use a U.S. civil aircraft with an experimental certificate to conduct operations such as air-to-air combat simulations, electronic counter measures, target towing for aerial gunnery, and/or dropping simulated ordinances pursuant to a contract or other agreement with a foreign government or other foreign entity would not be doing so in accordance with any authority granted by the FAA as the State of Registry or State of the Operator. These activities are not included in the list of experimental certificate approved operations and may be subject to enforcement action by FAA. For those experimental aircraft operating overseas *within* the limitations of their certificate, FAA Order 8130.2, section 7, paragraph 4071(b) states that if an experimental airworthiness certificate is issued to an aircraft located in or outside of the United States for time-limited operations in another country, the experimental airworthiness certificate must be accompanied by appropriate operating limitations that have been coordinated with the responsible CAA *before* issuance." For additional information on public aircraft status, refer to 76 FR 16349, Notice of Policy Regarding Civil Aircraft Operators Providing Contract Support to Government Entities (Public Aircraft Operations), and dated March 23, 2011.	
307.	TO 00-80G-1 and Display Safety	Recommend using TO 00-80G-1, Make Safe Procedures for Public Static Display, dated November 30, 2002, in preparing for display of the aircraft. This document addresses public safety around aircraft in the air show/display environment. It covers hydraulics, egress systems, fuel, arresting hooks, electrical, emergency power, pneumatic, air or ground launched missiles, weapons release (including inert rounds), access panels, antennas, and other equipment that can create a hazard peculiar to certain aircraft.	

Issue #	Issue(s)	Recommended Review, Action(s), and Coordination with Applicant	Notes, Action(s) Taken, and Disposition
MiG-23 Risk Management, SOPs, and Best Practices			
308.	Operational Risk Management (ORM) OPNAVINST 3500.39C	In addition to existing FAA SMS (Safety Management Systems, see www.faa.gov/about/initiatives/sms/reference_library), recommend an ORM-like approach be implemented by the MiG-23 owner/operator. The use of ORM principles in OPNAVINST 3500.39C will go a long way in enhancing the safe operation of tactical aircraft like the MiG-23 aircraft. The U.S. Navy's ORM employs a five-step process: (1) Identify hazards, (2) Assess hazards, (3) Make risk decisions, (4) Implement controls, and (5) Supervise. ORM is a systematic, decision making process used to identify and manage hazards. ORM is a tool used to make informed decisions by providing the best baseline of knowledge and experience available. Its purpose is to increase safety by anticipating hazards and reducing the potential for loss. The ORM process is utilized on three levels based upon time and assets available. These include: (1) Time-critical: A quick mental review of the five-step process when time does not allow for any more (that is, in-flight mission/situation changes), (2) Deliberate: Experience and brain storming are used to identify hazards and is best done in groups (that is, aircraft moves, fly on/off), (3) In-depth: More substantial tools are used to thoroughly study the hazards and their associated risk in complex operations. The ORM process includes the following principles: Accept no unnecessary risk, anticipate and manage risk by planning and make risk decisions at the right level. Refer to OPNAVINST 3500.39C, ORM, July 2, 2010. *Source: OPNAVINST 3500.39C*  Note: The following Air Force press release is a ORM-based analysis of a 2011 jet trainer accident: "*CULTURE OF RISK TOLERANCE' CITED IN CRASH PROBE* - 9/1/2011 - RANDOLPH AIR FORCE BASE, Texas --Investigators found that the Feb. 11 crash landing at Ellington Field, Texas, resulted from a series of mistakes by a fatigued pilot during landing, and they admonished the pilot's squadron for creating a 'culture of risk tolerance.' The pilot, from the 14th Flying Training Wing at Columbus Air Force Base, Miss., became disoriented and misjudged the landing runway, lost altitude too quickly and allowed his airspeed to fall below a safe level, according to the Air Education and Training Command accident investigation report. This resulted in catastrophic damage to the [aircraft's] landing gear and right wing. The mishap occurred during the fourth sortie of the day as a night solo continuations-training mission into Ellington Field, near Houston, on a squadron cross-country sortie. The pilot safely departed the aircraft when it came to rest on the ground, and he sustained only minor injuries. In addition to the culture of risk tolerance, the report cited inadequate operational risk management of the cross-country weekend plan. 'Inappropriate supervisory policy, combined with inadequate ORM, led to the mishap pilot flying a high-risk mission profile,' the report said. The board further found that the pilot's fatigue, resulting from the aggressive flight plan approved by his squadron, substantially contributed to the mishap. 'Outside of these cross-country weekends, it was rare for an (instructor pilot) to fly four sorties in one day. There was a mindset that a day consisting of four continuation training sorties was generally less risky than a day consisting of three student pilot instructional sorties,' the report said. 'The sortie was (the mishap pilot's) fourth sortie of the day and was flown entirely at night... This mishap was caused by the authorization and execution of a mission having an unnecessarily high level of risk relative to the real benefits.' Damage to the [aircraft] -- landing gear, engines, right wing, and tail section -- was assessed at $2.1 million. The impact also caused minor damage to the runway, but no damage to private property, the report said. According to Col. Creig A. Rice, AETC director of safety, risk mitigations were put in place to address the issues outlined in the accident investigation report." See http://www.torch.aetc.af.mil/news/story.asp?id=123277394.	

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309.	System Safety MIL-STD-882B	Recommend the use of MIL-STD-882B, System Safety Program Requirements, in the operation of the aircraft. This guidance is also useful in the maintenance and operation of high-performance former military aircraft. It covers program management, risk identification, audits, and other safety-related practices. MIL-STD-882B discusses the system safety requirements to perform throughout the life cycle for any system, new development, upgrade, modification, resolution of deficiencies, or technology development. When properly applied, these requirements should ensure the identification and understanding of all known hazards and their associated risks; and mishap risk eliminated or reduced to acceptable levels. The objective of system safety is to achieve acceptable mishap risk through a systematic approach of hazard analysis, risk assessment, and risk management. This document delineates the minimum mandatory requirements for an acceptable system safety program for any DOD system. See http://www.faa.gov/library/manuals/aviation/risk_management/ss_handbook/media/app_h_1200.PDF.	
310.	Cockpit Resource Management (CRM) and Single-Pilot Resource Management (SRM)	Recommended the applicant and operator adopt a CRM-type program for aircraft operations. While CRM focuses on pilots operating in crew environments, many of the concepts apply to single-pilot operations. Many CRM principles have been successfully applied to single-pilot aircraft, and led to the development of SRM. SRM is defined as the art and science of managing all the resources (both on board the aircraft and from outside sources) available to a single pilot (before and during flight) to ensure the successful outcome of the flight. SRM includes the concepts of Risk Management (RM), Task Management I, Automation Management (AM), Controlled Flight Into Terrain (CFIT) Awareness, and Situational Awareness (SA). SRM training helps the pilot maintain situational awareness by managing the automation and associated aircraft control and navigation tasks. This enables the pilot to accurately assess and manage risk and make accurate and timely decisions. Integrated CRM/SRM incorporates the use of specifically defined behavioral skills into aviation operations. Standardized training strategies are to be used in such areas as academics, simulators, and flight training. Practicing CRM/SRM principles will serve to prevent mishaps that result from poor crew coordination. At first glance, crew resource management for the single pilot might seem paradoxical but it is not. While multi-pilot operations have traditionally been the focus of CRM training, many elements are applicable to the single pilot operation. The Aircraft Owners and Pilots Association's (AOPA) Flight Training described single-pilot CRM as "found in the realm of aeronautical decision making, which is simply a systematic approach that pilots use to consistently find the best course(s) of action in response to a given set of circumstances." Wilkerson, Dave. September 2008. From a U.S. Navy standpoint, OPNAVINST 1542.7C, Crew Resource Management Program, dated October 12, 2001, can be used as guidance. Also refer to CRM For the Single Pilot. *Vector* (May/June 2008). FAA guidance includes: Summers, Michele M., Ayers, Frank Ayers, Connolly, Thomas Connolly, and Robertson, Charles. *Managing Risk through Scenario Based Training, Single Pilot Resource Management, and Learner Centered Grading*, 2007, and Chapter 17, *Airplane Flying Handbook* FAA-H-8083-3A. Note: Consider the use of AFI 11-290/AETC Sup 1, Cockpit/Crew Resource Management Training Program.	
311.	LOSA Program	Recommend that MiG-23 operator consider the use of LOSA or Line Operations Safety Audits as part of its operation. It is being promoted by the Indian Air Force, one of the largest MiG-23 operators in the World. LOSA "is one method for monitoring normal flight operations for safety purposes. This program facilitates hazard identification through the analysis of actual in-flight performances. It facilitates understanding the situation that may have precipitated the exceedence of flight parameters by the crew. It is a tool for understanding of human errors in flight operations. It is used to identify the threats to aviation safety that lead to human errors, to minimize the risks that such threats may generate and to implement measures to manage these errors within the operational context. LOSA enables operators to assess their resistance to operational risks and errors by front-line personnel. Using a data-driven approach, they can prioritize these risks and identify actions to reduce the risk of accidents. By observing normal day-to-day flight operations, data about flight crew performance and situational factors are collected. Thus, LOSA facilitates understanding both successful performance and failures. Hazards originating from operational errors can be identified and effective countermeasures developed. LOSA uses experienced and specially trained observers to collect data about flight crew performance and situational factors on "normal" flights. During audited flights, observers record error-inducing circumstances and the crew's responses to them. The audits are conducted under strict non-punitive conditions, without fear of disciplinary action for detected errors. Flight crews are not required to justify their actions. Data from LOSA also provide a picture of system operations that can guide strategies in regard to safety management, training, and operations. Data collected through LOSA can provide a rich source of information for the proactive identification of systemic safety hazards. A big advantage of LOSA is that it identifies examples of superior performance that can be reinforced and used as models for training. (Traditionally, the aviation industry has collected information on failed performance and revised training programs accordingly.) With LOSA, training interventions can be based on the most successful operational performance. For example, based on LOSA data, CRM training can be modified to reflect best practices for coping with particular types of unsafe conditions and for managing typical errors related to these conditions. ICAO (International Civil Aviation Organization) endorses LOSA as a way to monitor normal flight operations. ICAO has published a manual, Line Operations Safety Audit (LOSA) (Doc 9803), to provide guidance to operators regarding LOSA programs." See http://indianairforce.nic.in/fsmagazines/JAN%202013.pdf.	
312.	Safety Culture	Recommend the establishment of safety culture policy and associated processes for the operator. Safety culture is descriptive of organizations where each person involved in the organization's operations recognizes and acts on his or her individual responsibility for safety, and actively supports the organization's processes for managing safety. The outcome is that the organization's ability to manage safety continues to improve because decision makers at all levels work to use their knowledge of safety risk to learn and adapt, thus improving the system's ability to support safety outcomes.	

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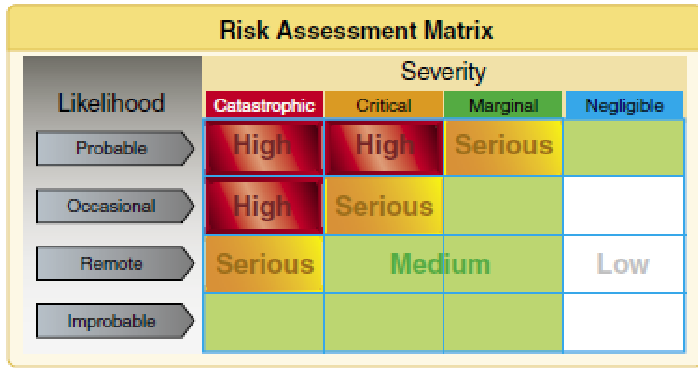
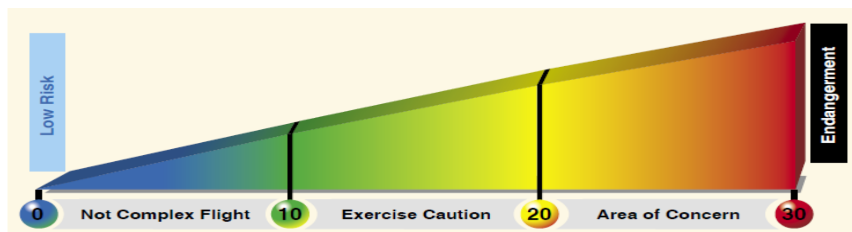
<tr><th>Issue #</th><th>Issue(s)</th><th>Recommended Review, Action(s), and Coordination with Applicant</th><th>Notes, Action(s) Taken, and Disposition</th></tr>
<tr><td>313.</td><td>Risk Matrix and Risk Assessment Tool</td><td>Recommend using a risk matrix in mitigating risk in aircraft operations. A risk matrix can be used for almost any operation by assigning likelihood and consequence. In the case presented, the pilot assigned a likelihood of occasional and the severity as catastrophic. As one can see, this falls in the high risk area. The following is a risk assessment tool presented in figure 17-5 of the Airplane Flying Handbook, FAA-H-8083-3A.





Source: FAA</td><td></td></tr>
<tr><td>314.</td><td>AFM Addendums</td><td>Consider additions or restrictions to the AFM. Operational restrictions should be also addressed in the AFM.</td><td></td></tr>
<tr><td>315.</td><td>Training Guidance</td><td>Recommend the applicable training manuals and materials be used as an integral part of the operation of the aircraft. This may include training films and training pamphlets (common in the Soviet Air Force).</td><td></td></tr>
<tr><td>316.</td><td>USAF Phase Training</td><td>Recommend SOPs and training incorporate the current USAF Phases of Training. These include—

Initial Qualification Training (IQT). This training is necessary to qualify aircrew for duties in the aircraft;
Mission Qualification Training (MQT). This training is necessary to qualify aircrew for specific unit mission or local area requirements;
Continuation Training (CT). This training is necessary for qualified aircrew to maintain their assigned level of proficiency and/or increase flight qualifications. It provides minimum ground and flight training event requirements.
</td><td></td></tr>
<tr><td>317.</td><td>MiG-23 Expertise</td><td>It is highly recommended that as part or any restoration, maintenance, and operations, support from personnel with MiG-23 experience be sought. A high level of expertise in all aspects of the operation of the aircraft is necessary. As an example, as part of an ongoing MiG-23 restoration project, it was noted that “One of our new associates is a former Russian pilot and MiG-23 instructor who is currently employed at a major flight training center at DFW. He is a big help with systems knowledge and practical experience in the MiG-23.” http://blog.cwam.org/search?updated-max=2010-02-04T00:00:00-06:00&max-results=4&start=92&by-date=false.</td><td></td></tr>
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Issue #	Issue(s)	Recommended Review, Action(s), and Coordination with Applicant	Notes, Action(s) Taken, and Disposition
318.	Indian Air Force (IAF) Flight Safety Strategy and Manual of Flight Safety Management (IAP 3030)	Recommend the IAF Flight Safety Strategy document be incorporated into the operations of the aircraft. The IAF's operational experience with the aircraft and its shortcomings and accident history justify this recommendation. It states in part: "A Flight Safety organization has been functioning in the IAF since 1960. Procedures of flight safety management at various levels have been outlined in the Manual of Flight Safety Management (IAP 3030). The mission of the Flight Safety organization of the IAF is to ensure operational capability by conserving human and material resources through prevention of aircraft accidents. As risk is inherent in military aviation, it has to be assessed and managed effectively. In order to accomplish the mission safely, a well-defined strategy is given in the subsequent paragraphs." Refer to http://indianairforce.nic.in/show_page.php?pg_id=117.	
319.	IAF *Defect Investigation/Failure Analysis*	Recommend that the Indian Air Force *Defect Investigation/Failure Analysis* for the MiG-23/MiG-27 be consulted, and to the extent practicable, be considered as part of the operation and maintenance of the aircraft. This study/program by the IAF tracks and analyses premature withdrawals of equipment and components from frontline units and reviews and investigates the causes for defects/failures. As a byproduct, repetitive cases are then taken up for in-depth study and modifications are incorporated in the units to minimize the recurrence of such defects/failures in future. Such data will be very valuable in ensure a higher level of safety in any MiG-23/MiG-27 civil operation.	
320.	In-Flight Canopy Separation	Revise the pilot checklist and back seat (MiG-23UB) occupant briefing to emphasize (that is, "warning—caution") the proper closing of the canopy.	
321.	Fuel Mismanagement	Require special emphasis on fuel starvation and fuel management. Operator must be aware that it is important to note the total fuel load and compare to the fuel counters to determine accuracy. A civil MiG-23 pilot explains: "there is no fuel quantity gauge on the 23 (MiG-23) only a fuel burned counter that is displayed as fuel remaining. You must set it before take-off for the load you have onboard. I did not take off with a full load, but since the amount remaining after testing was only a guess, we opted to put all that we needed plus reserve in and not count test fuel remaining." http://www.warbirdsofdelaware.com/Airplanes/MiG23/MiG23PilotReport/. It is recommended, in addition to actual fuel consumption, that over-conservative flight time figures be used in all flights, such as a maximum of 30 minutes.	
322.	Speed Limitations Due To Avionics and Other Equipment	Verify the speed limit of the aircraft is adjusted to address installed avionics, which may have speed limitations. This is likely to be an issue because many former military aircraft are equipped with civilian avionics, and external components, including antennae, nay not have been cleared for the speed ranges in which the aircraft may be operated.	
323.	Brake Application, Steering System	Recommend SOPs and training focus on the proper application of braking action during landing, especially in unusual circumstances. The proper transition from ground control (brake and steering to aerodynamic control (flight Controls) are critical. Recommend an adequate check-out on the aircraft's brake and steering system has been given to anyone taking control of the aircraft on the ground. This is important in the MiG-23 due to the difficulties that exists in taxing the aircraft.	
324.	Taxiing	Recommend that SOPs and training provide for an adequate check-out on the aircraft's brake and steering system has been given to anyone taking control of the aircraft on the ground. This is important in the MiG-23 due to the difficulties that exists in taxing the aircraft. Moreover, the flight manual also recommends taxi with wing swept. See http://blog.cwam.org/search?updated-max=2009-11-08T18:00:00-06:00&max-results=4&start=132&by-date=false for a video of the difficulties encountered by a MiG-23 restorer during taxiing runs. The following narrative illustrates this feature of the MiG-23: "The nose wheel steering struck me as being unusually sensitive. I found myself, despite my best efforts, S-turning the aircraft down the taxiway…" Lambeth, 1994.	
325.	Command Ejection	In the MiG-23UB two-seater, ensure SOPs address the command ejection issue, that is, who ejects first, per the appropriate guidance before the flight if the back seat or rear seat is occupied. A US civil pilot who flew in a Russian AF MiG-23UB in 1994 said the following concerning the command ejection issue on the aircraft: "the MiG-23UB has a sequenced ejection capability, which was selected to aft-cockpit control for our flight. That meant that Gorbunov [instructor in the back seat] could command my ejection in the remote chance that we experienced an emergency requiring immediate abandonment of the aircraft." Lambeth, 1994.	
326.	Weight Limits for the Ejection Seats	If the ejection seat is active, procedures should ensure that for every flight, the weight of any occupant meets any design requirements. Other limitations may also be applicable, and SOPs and training need to address this.	

Issue #	Issue(s)	Recommended Review, Action(s), and Coordination with Applicant	Notes, Action(s) Taken, and Disposition
327.	High AOA, Loss of Control (LOC), and Abrupt Maneuvering	Ensure SOPs and training not only emphasizes the risk of high AOA operations and considers asking that procedures/training be adopted accordingly, but also limits the possibility of a LOC event due to abrupt maneuvering. It is well documented that the MiG-23 has unusual yaw characteristics at high speed, making it prone to LOC. It has also been documented that abrupt maneuvering has caused engine failures followed by an engine fire. Many MiG-23s have been lost due to LOC. The following account by a US pilot who flew in a Russian AF MiG-23UB illustrates this issue: "The loop maneuver was initiated in military power at 485 knots… I did not keep a close eye on altitude changes, other than to be watchful of our assigned floor and ceiling for maneuvering. The AOA gauge was redlined at 18°. I noted that I had allowed the aircraft to go slightly into the red as we entered the float inverted at around 215 knots. The aircraft showed no tendency to wing-rock or nose-slice, however, and we continued down the back side of the loop with steadily increasing g for a level recovery at more or less our entry altitude. The MiG-23 has some wicked departure and pro-spin characteristics at high AOA." Lambeth, 1994,	
328.	Lack of Artificial Feel	Recommend that SOPs and training focus on the MiG-23's lack of "feel." A civil MiG-23 pilot explains: "During subsequent flights I try the wing sweep, climb it higher, and accelerate it to higher speeds and work up to a good feel for the aircraft. In these aircraft, it takes a lot more awareness to "feel" the MiG 23. The hydraulic flight controls have no artificial feel built into them. While the stick travel and force remains the same with varying airspeed, the amount of elevator travel decreases as speed increases. When the wings sweep, there is no trim input required from the pilot. This is automatic. When trimmed and flying level at 300 knots, moving the wings from 16 degrees to 45 degrees, without changing anything else results in the stick moving forward about ½ inch and speed increasing 25 knots. http://www.warbirdsofdelaware.com/Airplanes/MiG23/MiG23PilotReport/tabid/87/Default.aspx.	
329.	Throttle Inhibitor	Ensure SOPs and training cover the correct use of the throttle inhibitor.	
330.	Swing-Wing 16° Speed Limit	SOPs and training need to emphasize the applicable speed limits for the specific swing-wing position. The following 1988 Polish Air Force MiG-23MF accident illustrates this: "14 July 1988. Pilot Lieutenant Engineer Ovcharek Krzysztof had a total of 628 hours in airplanes, about 302 hours in the MiG-23. It was a night intercept mission. The circumstances of the accident: after the interception, the pilot is likely to have exceeded the speed limit set for the wing angle 16° and lost control of the aircraft. He did not attempt to bail out. Reason: exceeding the speed limit for the position of the wing creates an aerodynamic phenomenon which the pilot was not prepared to handle." http://aviacrash.ucoz.ru/load/aviacija_pnr/katastrofy_1971_1980_chast_3/6-1-0-91.	

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331.	Stuck Throttle	Verify that the SOPs include handling a possible stuck throttle. Stuck throttles have caused several MiG-23 accidents. The following incident narrative illustrates this: "I used to jump at any opportunity for air test sorties as it gave a kind of excitement, when you could take the aircraft to the limit of its envelope and bring it back safely so that others could fly it. This enthusiasm was always a calculated one as in aviation there are no old and bold pilots. I landed an aircraft when it didn't want to. One of the various probabilities when an aircraft is unwilling land, (you start thinking of it having a mind of its own rather than being just a piece of machinery), is when the throttle refuses to move back. So what do you do? Use all your strength gained in the gym to pull back the throttle, switch on some switch like relight (which opens the jet nozzle thus reducing thrust) in the hope of reducing speed, use airbrakes, turn with high 'g' and if nothing happens start praying. As for me, I was a little prepared in the sense that it was an air test sortie after an engine rectification. By this time, I have had some experience in handling emergencies of all types I used to jump at any opportunity of flying air test sorties as it gave a kind of excitement, when you could take the aircraft to its limit envelope and bring it back safely so that others could fly it. This enthusiasm was always calculated as in aviation there is nothing like an old and bold pilot. So, on this particularly fine day, I raised the nose of the aircraft and got airborne. At a safe height, after a few maneuvers, I wanted to get the throttle back to reduce speed for a flight check and to check its response during recovery in a low speed high angle of attack envelope. But the throttle refused to budge. The RPM refused to come below 78% with all my strength on the throttle and when left free of this force, it moved ahead to about 83%. As the emergency was announced, I could feel the hushed silence descending on ATC. This type of emergency was also not mentioned anywhere in the FLIP card of the aircraft which the DATCO could refer. I could imagine the frantic calls to AOC, COO, SFS& IO, CO of the squadron. Strangely, I never felt any panic during this episode. We had this type of emergency earlier in different aircrafts and in various forums these were discussed in detail to teach pilots in aircraft. So at no point of time, I had any doubt on how to recover the aircraft safely? Maybe this self-assurance gave me the inner calm which kept me composed. Anyway, I executed a near perfect landing with the throttle in the same position and deployed the tail chute that tore to shreds because of the hot jet wake. Brake application was judicious as later I learnt that the technicians did not have to cool any of the wheels. By the end of the runway, the aircraft was under control with the engine still running at 83% RPM instead of the ground idle RPM of 57%. I could see a cloud of dust being raised through the rear view mirror. There was only one way to switch off the aircraft from the cockpit and that was by using the LP cock. But instead of doing it on the ORP, I decided to taxi back to dispersal as no parked aircraft came in line of my aircraft's jet wake. This was the one and only mistake I committed that day which was noticed by all. I did not even get a good show for the near perfect landing. In hindsight, I should have switched off on the ORP and not taxied to dispersal. My concern was that the air cylinders for cooling the hot wheels would take some time to be brought to the ORP and the tires would deflate by then. With this, the aircraft may sink and cause subsidiary damage to its ventral fin. After recovering the aircraft safely, I did not want anything to happen to it at least on ground. Hence, instead of waiting at the ORP, I decided to go to the dispersal I was sure the cylinders were. Big mistake! Later it was found that a semi flexible hose had got disconnected and lodged behind the throttle linkage. This provided a physical barrier. I was closely monitoring the whole investigation and found that if I had applied positive or negative 'g', this hose could have come out of its lodging and the throttle would have been free of its restriction. This was a valuable lesson I learnt that day. And this lesson proved very useful in recovering another aircraft in somewhere else. This new unit of mine had the same type of aircraft but a different version. Another pilot, same aircraft, same emergency. I was officiating as SFS&IO when this particular incident happened. So, I had the privilege of the portable phone communication set and a service vehicle. As soon as the emergency was announced, I jumped in my vehicle and shot off to the ATC, double and triple stepping the stairs. On reaching the tower, I found the aircraft with undercarriage down on circuit at the end of downwind. And the pilot was not able to move the throttle back. Speed was high and time was running short. In a flash, my previous experience flashed. I immediately asked the pilot, through the SFS, to apply positive and negative 'g' and simultaneously move the throttle back. He complied instantaneously and, lo behold, the throttle moved back. There was no restriction of any type thereafter and he was able to execute a normal landing. This emergency could have proved catastrophic, as the pilot was relatively inexperienced. Later, even after complete strip analysis, nothing amiss was pinpointed which could have caused an obstruction to the throttle movement. However, I realized what a disaster it could have been if Mr. Murphy was present that day. An emergency that is common in all aircraft could prove disastrous. If just a simple 'shaking' of the aircraft by positive and negative 'g' could dislodge any foreign object from its lodging, the same foreign object could get stuck in some other more critical area from where it may not dislodge for throttle movement resulting in catastrophe. So whenever you learn a lesson, beware the same may not apply universally. Keep your wits about and then apply knowledge and experience. *- Wing Cdr. Sahu is posted to 2255 Sqn AF." http://www.indianairforce.nic.in/fsmagazines/Jun10.pdf.*	
332.	Airspeed Management on Final Approach	Recommend the establishments of training and SOPs to address the proper management of airspeed on final approach.	
333.	Touchdown and Deceleration Technique	In conjunction with the applicable AFM, and any specifics on the aircraft, recommend establishing procedures for correct touchdown and deceleration procedures. This standard for the MiG-23 may involve the proper sequencing of actions following touchdown, that is, touchdown at the correct speed, allowing the nose wheel to contact the runway immediately, holding the stick forward, engaging the nose wheel steering, deploying the drag chute, retracting the speed brakes and flaps, and anti-skid testing.	
334.	Drag Chute	Recommend that SOPs and training focus on the use of the drag chute as per the applicable guidance. This was a common MiG-23 failure.	
335.	Air Start Procedures	Ensure SOPs emphasize the correct emphasizes on air start procedures. This has been the cause of several accidents involving former military high-performance aircraft.	

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336.	Configuration Checks	Recommend SOPs and training focus on configuration checks.	
337.	Warning and Caution Light System	Recommend SOPs and training emphasize the correct interpretation of the warning and caution light systems in the aircraft.	
338.	Fuel Leaks	Recommend that SOPs (not just for maintenance, but servicing and flight crew as well) address and with extreme caution, the high potential for fuel leaks in the MiG-23. This poses a serious safety concern, not just for the aircraft in flight for example, but also in terms of ground safety. It is a fact that, over time, there is a tendency by operators to treat fuel leaks as a "common" occurrence, and in due time, this has created serious, and sometimes, fatal situations. The following is the account of one such incident: "On December 23, 2010, Sgt. Reddy and Sgt. Bhaskar were detailed to carry out external checks during super structure run on MiG-27 aircraft. During the ground run, gas leak was observed from the starboard side of the aircraft. The exact location of gas leak was difficult to check because of visual obstruction by Main EDP. After EDP removal in subsequent SS ground run hot gas leak was noticed from two places of mating of CCOC flange with rear flange of compressor on starboard side. This was confirmed by representatives of HAL also. If this leak had gone unnoticed it could have had serious flight safety implications." http://indianairforce.nic.in/fsmagazines/Aug11.pdf. Also see *The 2009 Crash of ZU-BEX* above.	
339.	Oxygen Check	Recommend SOPs and training require the pilot to perform the "PRICE" check on the oxygen equipment (PRESSURE, REGULATOR, INDICATOR, CONNECTIONS, and EMERGENCY) before every flight if a pressure oxygen system is installed. The acronym PRICE is a checklist memory-jogger that helps pilots and crewmembers inspect oxygen equipment. Mix and match components with caution. When interchanging oxygen systems components, ensure compatibility of the components storage containers, regulators, and masks. This is a particularly important issue because the age of the aircraft may require the use of modern equipment, at least for some components.	
340.	Spool Down Time	Ensure SOPs incorporate noting the spool down time of the engine after shutdown. This is critical, as it could indicate an upcoming problem with the engine.	
341.	End of Runway (EOR) Check	Recommend SOPs and training emphasize the importance of an EOR (or Last Chance) check. This was a common Soviet practice, even when the aircraft was not armed.	
342.	Acceleration Check and Takeoff Computations	Recommend computation of a 2,000 ft. acceleration check speed anytime the computed takeoff roll exceeds 2,500 ft. When the computed takeoff roll is 2,500 ft. or less, use the actual takeoff distance versus the computed takeoff distance to evaluate aircraft performance. Compute a refusal speed for all takeoffs. This is a standard USAF practice. Practically, this involves an acceleration check speed, which is using a ground reference during the takeoff run to check for a pre-calculated speed.	
343.	Take-Off Flaps	Recommend SOPs and training focus on the proper flap setting for take-off and the particularities of the system, which may requires special considerations. For example, a MiG-23 pilot may take up to 20 seconds in position. This is because the pilot cannot set take off flaps before lining up on the runway because selecting any flaps will automatically place nose wheel steering to low position which will not allow enough turn to align with the runway.	
344.	Asymmetric Flaps	Recommend that SOPs and training address the possibility of an asymmetric flap situation. This has happened in MiG-23s. The following incident narrative illustrates this: "On Oct 12, 2010, Wing Cdr. Mukul and Wing Cdr. Emmanuel were authorized to fly a sortie in a MiG-23UB aircraft. On downwind, on lowering flaps, the aircraft started rolling to the left with the ball fully to the left. On short finals, as the speeds reduced, the roll could barely be countered with almost full stick deflection to the right. The pilots quickly analyzed the situation and executed an overshoot. Thereafter, a flawless flapless approach and landing was executed which demands precision, especially by dark night. Post flight analysis revealed asymmetric lowering of flaps wherein starboard flap was fully down while the port flap was almost up, leading to vicious left roll." http://indianairforce.nic.in/fsmagazines/Aug11.pdf.	
345.	Engine Failure	It is essential that the possibility of an engine failure be taken into account before flight. Notwithstanding the fact that the MiG-23 operational history is plagued with such failures, the other issue is that an engine failure in the MiG-23 will be fatal and requires quick action, which cannot endanger people or property on the ground. An engine overheat light may be followed by an in-light fire or explosion very quickly. The following 1984 account of an East German Air Force MiG-23 accident illustrates this: "599, a MiG-23ML (serial number 0390324047, use beginning 07/82) crashed after engine fire due to a faulty compressor. The pilot, Lieutenant Colonel Karl-Heinz Gunther ejected successfully, but drowned in the Baltic Sea. Shortly after take-off, the "engine overheat light came on. The pilot shut off the afterburner and declared an emergency. He attempted to change engine parameters, but suddenly there was the explosion of the fuselage fuel tank. This impact resulted in a LOC and the aircraft entered a dive. Since the resulting situation was clearly life threatening, the pilot ejected. He broke his arms during the ejection, and when he was picked up by a SAR Mi-8 from Brandenburg, unfortunately it was too late. They found him lifeless state. The doctor could only confirm the death by drowning." http://home.snafu.de/veith/verluste9.htm.	

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346.	Landing Pattern Fuel	Ensure SOPs require a minimum amount (i.e., 1,200 lb.) of fuel for a circuit, landing, and possible going around.	
347.	Asymmetric Slat Deployment	If the MiG-23/MiG-27 version in question has slats, recommend that SOPs and training emphasize the possibility of asymmetric deployment. Consider restricting aerobatics at low altitude with slats operational (not physically immobilized).	
348.	Specific Range	Recommend SOPs address minimum landing fuel. Verify actual aircraft-specific range (nautical air miles traveled per pound of fuel used). This varies depending on the version and variant. For example, the latest Soviet MiG-23 version was also special on one thing: It has actually less fuel (3,700 kg) than the MS/MF (4090 kg) due to the removal of fuel-tank No. 4 (390 kg), but the improved efficiency of the R-35 engine & the lighter gross weights give it a 50 to 10 km better radius. These types of differences must be considered.	
349.	Bingo and Minimum Landing Fuel	Recommend establishing SOPs addressing minimum landing fuel for IFR operations as provided in § 91.151, Fuel Requirements for Flight in VFR Conditions, in addition to § 91.167, to add a level of safety. In addition, a "Bingo" fuel status (a re-briefed amount of fuel for an aircraft that would allow a safe return to the base of intended landing) should be used in all flights. Note: Bingo fuel and minimum landing fuel are not necessarily the same, in that a call for Bingo fuel and a return to base still require managing the minimum landing fuel, which in the MiG-23 is about 1,000 liters. See *Flight Time Block and Cross-Country Operations* below.	
350.	Flight Time Block and Cross-Country Operations	Because of the aircraft's notorious short range, recommend that in addition to Bingo and minimum landing fuel (see above), operators consider using a very conservative flight time block (i.e., maximum of 45 minutes) to ensure an additional level of safety to mitigate against any low-fuel situation, especially in cross-country operations.	
351.	Suspected Flight Control Failure	Recommend establishing SOPs for troubleshooting suspected in-flight control failures, that is, specific checklist procedures, altitude, and clear location. This is very important due to the aircrafts' history of flight control problems.	
352.	Minimum Flying Speed	Recommend that SOPs and training properly balance a safe minimum operating speed within the scope of the applicable regulations and procedures. Maintaining a safe airspeed needs to be properly considered in conjunction with any regulatory maximum airspeed, such as the 250-knot limit below 10,000 feet. In other words, balancing the safety of the aircraft's operation with that of other traffic, and ATC, must be considered. It could, in some cases, require alternate mitigating measures. In some cases, operations within certain types of airspace may not be possible. On this issue, coordination between the operator and the FSDO must take place. References to consider include § 91.117 Aircraft Speed and FAA Order JO 7110.65U Section 7- Speed Adjustment.	
353.	Rejected Takeoff	Recommend SOPs and training address the abort decision. Many MiG-23 accidents occurred because of poor planning and execution concerning an aborted take-off. Case in point, about 3 seconds after the afterburner lights, it is already too late to abort the take-off on a 7,000-foot runway. It takes about 3 seconds to turn off the burner and idle the engine. This is a serious risk that has to be properly mitigated.	
354.	Fuel Consumption and CG Shifting	Recommend emphasizing, though SOPs and training, that the PIC knows the automatic fuel sequencing on the MiG-23 (with or without external fuel tanks) and familiarity to address any of the aircraft's sensitivity to CG changes due to fuel consumption.	
355.	Over Rotation	Ensure SOPs and training emphasize the concern that an over rotation in a MiG-23 can cause a strike with the tail and tail-fin (currently rotated in a flat position for takeoffs). Any distortion of the fuselage is likely to result in the aircraft being grounded.	

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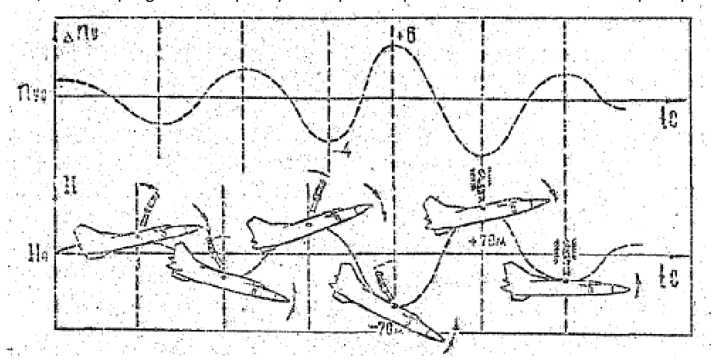
356.	Pilot Induced Oscillation (PIO)	Ensure SOPs and training emphasizes susceptibility to PIO on landing and takeoff. This phenomenon must be clearly understood by the PIC. Proper rotation and landing/flare technique is critical. Note: A PIO, as defined by MIL-HDBK-1797A, is a “sustained or uncontrollable oscillations resulting from efforts of the pilot to control the aircraft” and occurs when the pilot of an aircraft inadvertently commands an often increasing series of corrections in opposite directions, each an attempt to cover the aircraft’s reaction to the previous input with an overcorrection in the opposite direction. An aircraft in such a condition can appear to be “porpoising,” switching between upward and downward directions. As such, it is a coupling of the frequency of the pilot’s inputs and the aircraft’s own frequency. 	
357.	Tail Strike Prevention and Inspection	Recommend the vulnerabilities of the aircraft to tail strikes be considered, and appropriate training and SOPs adopted. Prevention and post-accident/incident inspections ought to be considered. Holding off on landing could result in a steep nose-up attitude with the danger of a tail strike. It needs to be a pre and post-flight inspection item. An Indian Air Force pilot noted that “landing the aircraft [MiG-23] without bouncing and touching its low tail was quite an art.” Gokhale, 2009. In Romanian AF service, the “MiG-23 was considered unstable and fairly difficult to land.” Vlad, 2004.	
358.	Stick Forces	Recommend that SOPs and training address the MiG-23’s stick forces, especially at certain speed ranges because they will likely be different than many other of the aircraft the pilot may be familiar with. For example, an IAF (Israeli Air Force) evaluation of the aircraft noted that during maneuvering, the stick forces were exhaustively high, requiring excessive trimming.	
359.	Autopilot Functions, and Dangerous Altitude Recovery	Recommend that if the aircraft has an original functional autopilot, that it be thoroughly understood. Several accidents have been caused by its failure, especially the pitch channel. The system may have functions not usually found in Western types. For example, some MiG-23s may have a ‘Dangerous Altitude Recovery’ mode on the auto pilot, which can be activated while descending past a certain altitude. However, Auto pilot failure has caused many accidents. For example, in 1993, the autopilot on a Romanian Air Force MiG-23 failed in the pitch channel, resulting in wild vertical oscillations - the aircraft became uncontrollable soon after take-off.	
360.	FAA AC 91-79	Recommend the use of AC 91-79, Runway Overrun Prevention. According to AC 91-79, safe landings begin long before touchdown. Adhering to SOPs and best practices for stabilized approaches will always be the first line of defense in preventing a runway overrun, common in MiG-23 operations.	
361.	FAA AC 61-107	Recommend the use of AC 61-107, Operations of Aircraft at Altitudes Above 25,000 ft. MSL and/or Mach Numbers (MMO) Greater Than 0.75. This AC can be used to assist pilots who are transitioning from aircraft with less performance capability to complex, high-performance aircraft that are capable of operating at high altitudes and high airspeeds. It also provides knowledge about the special physiological and aerodynamic considerations involved in these kinds of operations.	
362.	360-Degree Overhead Pattern Technique	Recommend the operator consider implementing SOPs to refrain from 360-degree overhead patterns. There is no civil application of this technique.	

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363.	Low Approaches, High Speed, Low-Altitude Passes	Recommend no impromptu "low approaches" be permitted in normal operations outside the approved Airshow routine and during the exhibition of the aircraft in that context. An exhibition airworthiness certificate is for exhibition purposes only. In many cases, operators engage in "spur-of-the-moment home airshows." Conducting such operations with an aircraft like the MiG-23 is not only inconsistent with the operating limitations typically issued, but is also a potentially dangerous activity because of (1) the lack of planning and coordination these operations entail, and (2) the inherent dangers of maneuvering this aircraft at low levels. Note: In a 2011 decision, the NTSB found that "high speed, low-altitude operations were intentional fly-bys, rather than go-arounds."	
364.	Limit the Use of the Afterburner	Recommend the use of the afterburner be limited to those phases of flight where it is actually necessary, such as takeoff. This is because there is some history of afterburner failures in the MiG-23 and more documented failures of engine failures and fires.	
365.	Crosswinds	Recommend the operator consider implementing SOPs that refer to conservative crosswind limitations (possibly more conservative than those in the AFM) and adhere to the appropriate crosswind landing techniques.	
366.	Drag Chute Failures (SOPs)	Ensure the PIC trains and assumes drag chute failure for all flights. This is because of the very high number of drag chute failures. Recommend the establishments of training and SOPs to focus on this. Effectively, the MiG-23 should not be operated with total dependence on the drag chute system to stop on available runway. The brake parachute is not to be relied upon to enable planned landing at a field shorter than that which would be required without this parachute. Note: The operation of the drag chute requires proper procedures, starting on the ground.	
367.	Periscope and Dual Instruction From the Rear Cockpit	SOPs and training need to address the intricacies of the use of the periscope and the limited visibility from the rear seat. This should cover any instructor pilot or DPE using the rear cockpit. Forward visibility from the back-seat of the MiG-23U (two-seater) is very poor. To improve the flight instructor's ability to see, a mirror/periscope system is installed. Note: The correct techniques must be flowed. In that respect (using the correct technique) it should be similar to flying from the back seat of an F-4 which was a difficult task for an F-4 instructor pilot.	
368.	Outdoors Storage	Recommend establishing SOPs to address the aircraft's sensitivities to weather, including hydraulic seal failures and leakages, freezing moisture, transparencies, air intake, and exhaust protection if necessary.	
369.	Reporting Malfunctions and Defects	Ask the applicant/operator to report (to the FSDO or MIDO) incidents, malfunctions, and equipment defects found in maintenance, preflight, flight, and post-flight inspection. This would yield significant safety benefits to operators and the FAA. A 2011 study for the U.S. Navy points to the effectiveness of such practices. It stated: "The data analysis carried out was a comprehensive attempt to examine the strength of the link between safety climate and mishap probability. Our findings would seem to support the premise that safety climate and safety performance are, at best, weakly related. Mishaps are rare events, and they describe only part of the spectrum of risks pertaining to a work system. We suggest that measuring workers' self-reported safety attitudes and behavior is an alternative way to assess the discriminate validity of safety climate." O'Connor, October 2011. In other words, reporting safety issues, such as malfunctions, goes a long way in preventing an accident. Note: As an element of reducing accidents, notably MiG-23/MiG-27 accidents, the Indian Air Force uses the "Air Force System on Error Management" (AFSEM) process. This process provides a platform to all operational personnel to report any type of unsafe act/event, errors, and violations which may undermine safety of the IAF. AFSEM facilitates anonymous reporting of the faults and utilizes them as a vital source of information for predictive capability and subsequent formulation of accident preventive program. Aviation history has shown that for every single fatal Cat-1 accident [Class A Mishap] which has occurred in aviation field, there were 10 non-fatal accidents preceded by 30 reportable incidents which were further preceded by 600 unreported, unsafe acts. The IAF today faces the challenge of addressing the unreported and unsafe acts/ errors related with flying operations at the field units. The errors, violations and unsafe acts, if left neglected, have proved to be a potent source of incidents and accidents." http://indianairforce.nic.in/fsmagazines/Dec11.pdf.	
370.	Film "Operation, Maintenance and Repair of MiG-23 and MiG-27 Aircraft"	Recommend that the film "Operation, Maintenance, and Repair of MiG-23 and MiG-27 Aircraft" be incorporated into the maintenance and operations of the aircraft. This 2008 film by the Ukroboronservice State Company, jointly with the State Enterprise of the Ministry of Defense of Ukraine – Odessa Aircraft Repair Enterprise "Odesaviaremservice," illustrates several issues with the MiG-23 including "overhaul, on-condition maintenance, on-site repair, when the airframe is repaired at customer's base, service support, and technical maintenance of MiG-23 aircraft at customer's base." It also describes "offering an upgrade package to improve efficiency of MiG-23 aircraft. Ukroboronservice State Company, on the base of aircraft repair stations, manufactures an extensive range of spare parts for the MiG-23. It trains technicians in repair and maintenance of the MiG-23 and its units. Besides, the company trains pilots in the peculiarities of flying the MiG-23." http://www.aviafilm.com.ua/eng/index.php?topic=product&subtopic=more&id=692.	

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371.	Cockpit Familiarization	Recommend detailed and comprehensive SOPs/training (not unlike the military-style training known as “blindfold cockpit check with boldface items” conducted in a cockpit or cockpit simulator) be instituted to ensure adequate cockpit familiarization for the PIC. The following account by a US civil pilot who flew a Russian AF MiG-23UB in 1994 illustrates some of the cockpit and instrumentation issues with the aircraft: “The instrument panel is typical for Soviet fighters of the MiG-23's generation, featuring a familiar while stripe down the center, indicating where the pilot should place the control stick to neutralize aileron input and unload the aircraft in the event of a departure from controlled flight. The attitude-director indicator (ADI) is also distinctively "Soviet" in being earth-stabilized rather than aircraft stabilized. As in the MiG-29, it features a drum which rotates in the vertical plane to indicate pitch attitude, with a separate symbol which rotates through 360° of arc to denote angle of bank. The pilot has to integrate these two cues mentally to get a full attitude representation. I had found this instrument disconcerting when I encountered it in the MiG-29. After subsequent experiences in a Russian flight simulator and with Anatoly Kvochur in the Su-27, it fell quickly into hand, however. I noted that, as our pitch attitude in the MiG-23 approached the pure vertical, the instrument gave more precise bank-angle cues than does the standard Western ADI. As with the MiG-29, the aircraft is equipped with a combined angle-of-attack (AOA) gauge and g-meter, with g displayed on the right side and AOA on the left. Gorbunov told me that the MiG-23's AOA vane is unreliable at slow speeds and that I should plan on flying the airspeeds he had given to me. The cockpit is quite cluttered, without much ergonomic consideration, although the Russians have made major strides forward in cockpit "user-friendliness" in the MiG-29 and Su-27. They have yet to match the McDonnell Douglas F-18 or F-15 in this respect, however.” Lambeth, 1994.	
372.	Simulated Emergencies	Permit simulated emergencies only in accordance with the applicable AFM, including emergency and abnormal checklists and in accordance with the limitations issued by the FAA for the aircraft.	
373.	High-G Training	Recommend the PIC and any occupants received training, including techniques to mitigate the potential effects of high-G exposure if operations above 3 Gs are contemplated.	
374.	Transfer of Aircraft Control (MiG-23U)	Accidents have occurred with two pilots on board when both pilots thought the other was in control. It is recommended that before the flight, the PIC discuss with any other pilot (i.e., back seater in the MiG-23UB) the circumstances under which the PIC would (1) intercede and (2) take control of the aircraft. The transfer of control, could include the following exchange: PIC: "You have the flight controls" - Other pilot: "I have the flight controls" - PIC: "You have the flight controls." During the discussion, it is also recommended to establish whether the PIC wishes the other pilot to conduct any flight crew ancillary tasks. If so, these should be clearly specified to avoid confusion between the PIC and the other pilot. This is particularly important when events are moving quickly and the aircraft is in critical flight segments such as take-off or final approach to landing.	
375.	Use of Aft Cockpit Controls, Features, and Switches (MiG-23U)	SOPs and training should provide for procedures to ensure that all controls, features, and switches in the aft cockpit are not inadvertently operated or in any way interfere with the PIC in the front seat. The MiG-23 may be equipped with switches and functions in the back seat allowing an instructor to disable some instruments in the front cockpit to simulate failures. In addition, certain functions operated from the back seat will disable the similar function in the front seat, and this can create serious hazards unless properly understood and communicated.	
376.	Medical Fitness for Ejection Seats	Recommend the applicant/operator consider aircrew medical fitness as part of flight qualifications and preparation. In addition to meeting any ejection seat limitations (that is, weight and height) and seat-specific training, relevant U.S. military medical fitness standards could be used to ensure survival after ejection is maximized and injuries minimized. Ejection records show that when survivable, many ejections inflict serious injuries. Examples of aeromedical guidance include AFI 48-123, Medical Examinations, and Standards, dated May 22, 2001, and Army Regulation 40-501, Standards of Medical Fitness, dated June 14, 1989. Also refer to Defense and Civil Institute of Environmental Medicine, Department of National Defense, Canada. *Ejection Systems and the Human Factors: A Guide for Flight Surgeons and Aeromedical Trainers*, May 1988.	
377.	49 CFR Part 830	Ask the applicant/operator to adopt open and transparent SOPs that promote the use and requirements of 49 CFR Part 830, Notification And Reporting Of Aircraft Accidents or Incidents and Preservation of Aircraft Wreckage, Mail, Cargo, and Records, because there have been many instances where accidents and incidents are not reported, hindering safety. Occurrences, which are events other than an accident or incident (that requires investigation by the Flight Standards Service for its potential impact on safety), should also be reported. Occurrences include the following when no injury, damage, or § 830.5 reporting requirements are involved: (1) aborted takeoffs not involving a runway excursion, (2) air turn-backs where the aircraft returns to the departure airport and lands without incident, and (3) air diversions where the aircraft diverts to a different destination for reasons other than weather conditions. Reference should be made of FAA Order 8020.11, Aircraft Accident and Incident Notification, Investigation, and Reporting.	

Issue #	Issue(s)	Recommended Review, Action(s), and Coordination with Applicant	Notes, Action(s) Taken, and Disposition
378.	NATO Aviation Safety Guidance	Recommend the relevant sections of *Aviation Safety* AFSP-1(A), NATO, March 2007, be incorporated into the appropriate operational aspects of the operations to enhance overall safety. This document, which incorporates many safety issues concerning the safe operation of combat aircraft, sets out aviation safety principles, policies, and procedures—in particular those aimed at accident prevention. This document is a basic reference for everybody involved in aviation safety, both in occurrence prevention (starting from the development, testing, and introduction of material and procedures) and in its aftermath *(*the determination of the causes of an occurrence and the implementation of measures to prevent its recurrence). It is also recommended this process include internal safety audits. Safety audits help identify hazards and measure compliance with safety rules and standards. They assist in determining the adequate condition of work areas, adherence to safe work practices, and overall compliance with safety-based and risk-reduction procedures.	
379.	Aircrew Records	Recommend the applicant/operator establish and maintain processes to address aircrew qualifications and records. This could include pilot certification, competency, ground and flight training (records, instructors, conversion training, command training, and proficiency), medical, duty time, and flight time records.	
380.	BASH (Bird Strike Management)	Recommend that to the extent practicable, operations of the aircraft consider the basics of mitigating the hazards of bird strikes. USAF guidance, such as *Bird/Wildlife Aircraft Strike Hazard (BASH) Management Techniques*, AFP 91-212, February 1, 2004, can be used.	
381.	USAF AFI 91-202	Recommend the incorporation of USAF AFI 91-202, *The Mishap Prevention Program,* August 5, 2011, as part of the operation of the aircraft.	
382.	TSA Publication A-001	Recommend that operator become familiar with the Transportation Security Administration's (TSA) *Security Guidelines for General Aviation Airports*, Information Publication A-001, May 2004. This guidance document was developed by TSA, in cooperation with the General Aviation (GA) community. It is intended to provide GA airport owners, operators, and users with guidelines and recommendations that address aviation security concepts, technology, and enhancements. The recommendations contained in this document have been developed in close coordination with a Working Group comprised of individuals representing the entire spectrum of the GA industry. This material should be considered a living document which will be updated and modified as new security enhancements are developed and as input from the industry is received. To facilitate this, TSA has established a mailbox to collect feedback from interested parties. Persons wishing to provide input should send Email to General.Aviation@dhs.gov and insert "GA Airport Security" in the subject line.	
383.	National Warbird Operator Conference	Recommend the MiG-23 applicant/operator participate at the National Warbird Operator Conference (NWOC). Note: Founded in 1993, "the annual NWOC event brings together warbird owners, operators, and museum directors to address particular events facing warbird owners and to discuss common goals related to the ever-changing economics, operations, and regulations pertaining to flying ex-military aircraft. NWOC focuses on the exchange of ideas and information concerning the safe operation and restoration of warbird aircraft. This unique educational conference offers programs to enhance pilot skill and knowledge, expand aircraft maintenance technician and restorer knowledge, develop awareness of medical and insurance facts, and address aircraft-specific topics to ensure continued flight for these unique historic aircraft." http://www.warbirdconference.com/.	
384.	Insurance	It is recommended that the applicant/operator acquire the adequate type of insurance coverage. This is, and continues to be, an issue for many operators. However, the important role of insurance as part of an overall safety culture should not be underestimated. For example, EAA's Warbirds of America's insurance program "emphasizes *SAFETY,* utilizing various training syllabuses and safety forums," and includes "discounts available for participation in approved ground and flight safety programs." The adequate type of insurance coverage will greatly contribute to the safe operation of the aircraft because it involves an additional level of safety oversight that complements both the operator's and the FAA's.	
385.	Emergency Planning and Preparedness	Recommend the applicant/operator institute emergency plans and post-accident management SOPs that ensure the consequences of major incidents and accidents to aircraft are dealt with promptly and effectively.	

Attachment 4 - Additional Resources and References

Additional Resources

- MiG-23/27 accident data/reports, especially Indian Air Force reports and data.
- Indian Air Force Flight Safety guidance and magazine (Aerospace Safety).
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- Australia's CAAP 30-3(0), *Approved Maintenance Organization (AMO) — Limited Category Aircraft*, Civil Aviation Advisory Publication, December 2001. This publication addresses the restoration and maintenance of ex-military aircraft and is an excellent guide for developing adequate aircraft maintenance and inspection programs.
- CAP 632, *Operation of Permit to Fly Ex-Military Aircraft on the UK Register*. This is a comprehensive source of information and guidance on topics like technical requirements, specialist equipment and systems, pilot/crew qualification, operational requirements, records and oversight procedure, and safety management.
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- *Stall/Spin Problems of Military Aircraft.* AGARD-CP-199, NATO, November 1975.
- U.S. Department of Defense. Manual 4160.28 (volume 3), *Defense Demilitarization: Procedural Guidance,* June 7, 2011.
- USAF AFP 127-1 and NAVAIR 00-80T-116-2*, Technical Manual Safety Investigation, Volume II Investigative Techniques*, July 31, 1987.
- USAF TO 1-1-300, *Maintenance Operational Checks and Flight Checks*, June 15, 2012.
- USAF TO 1-1-691, *Corrosion Prevention, and Control Manual.*
- USAF TO 1-1A-1, *Engineering Handbook Series for Aircraft Repair, General Manual for Structural Repair*, November 15, 2006.

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Attachment 5 – Partial Listing of MiG-23/MiG-27 Accidents and Relevant Incidents

	Date	Version	Operator	Severity	Probable Cause & Remarks
1.	February 13, 2012	MiG-27M	Sri Lanka AF	Non-Fatal	Unknown
2.	January 12, 2012	MiG-27	Indian AF	Non-Fatal	Fuel Leak on Take-Off (AND)
3.	December 11, 2011	MiG-23	Indian AF	Non-Fatal	Inadvertent Drag Chute Deployment at Take-Off (AND)
4.	November 10, 2010	MiG-27ML	Indian AF	Non-Fatal	Engine Failure After Take-Off
5.	September 24, 2010	MiG-27ML	Indian AF	Non-Fatal	Unknown
6.	July 24, 2010	MiG-27ML	Indian AF	Fatal (4)	LOC – Hit residences, 4 killed, 25 injured
7.	February 16, 2010	MiG-27ML	Indian AF	Fatal (1)	Engine Fire During Take-Off
8.	October 23, 2009	MiG-27ML	Indian AF	Non-Fatal	Unknown (Civilian Ground Injuries)
9.	October 7, 2009	MiG-23UB	Libyan AF	Fatal (1)	LOC at Low Altitude (Airshow)
10.	May 15, 2009	MiG-27	Indian AF	Non-Fatal	Unknown – Aircraft Hit Residences, Injuring 7
11.	November 17, 2008	MiG-23UB	Indian AF	Non-Fatal	Mechanical Failure (Residence Destroyed)
12.	November 11, 2008	MiG-23UB	Angolan AF	Unknown	Unknown
13.	January 31, 2008	MiG-27	Indian AF	Nonfatal	Mechanical Failure
14.	October 19, 2006	MiG-27	Indian AF	Nonfatal	In-Flight Fire
15.	July 21, 2005	MiG-23MLD	Angolan AF	Fatal (1)	Unknown
16.	November 5, 2004	MiG-27M	Indian AF	Unknown	Unknown
17.	June 9, 2004	MiG-27M	Sri Lankan AF	Unknown	Engine Failure (Compressor Blades)
18.	May 19, 2004	MiG-27M	Indian AF	Fatal (1)	Unknown
19.	April 28, 2004	MiG-27M	Indian AF	Unknown	Unknown
20.	February 7, 2004	MiG-23BN	Indian AF	Fatal	Unknown
21.	July 7, 2003	MiG-23BN	Indian AF	Non-Fatal	Landing Gear Failure (Aircraft Destroyed)
22.	April 4, 2003	MiG-23BN	Indian AF	Fatal (1)	In-Flight Fire (Family of 6 killed on Ground)
23.	2003	MiG-23MF	Algerian AF	Fatal (1)	Unknown
24.	December 19, 2002	MiG-27ML	Indian AF	Nonfatal	Engine Fire
25.	September 30, 2002	MiG-23	Iraqi AF	Unknown	Unknown
26.	July 19, 2002	F-7P	Pakistan AF	Nonfatal	Engine Fire
27.	June 26, 2002	MiG-23BN	Indian AF	Non-Fatal	Engine Fire After Take-Off
28.	June 25, 2002	MiG-23BN	Indian AF	Unknown	Unknown
29.	June 7, 2002	MiG-27	Indian AF	Nonfatal	Caught Fire on the Runway (Pilot Burnt)
30.	May 17, 2002	MiG-23	Syrian AF	Unknown	Unknown
31.	March 15, 2002	MiG-23MF	Indian AF	Unknown	Unknown
32.	February 21, 2002	MiG-23BN	Indian AF	Unknown	Unknown (Aircraft Destroyed)
33.	September 2001	MiG-23MLD	Bulgarian AF	Non-Fatal	Unknown (Abort take-off)
34.	August 28, 2001	MiG-23BN	Indian AF	Non-Fatal	Unknown
35.	August 18, 2001	MiG-27	Sri Lankan AF	Fatal (5)	Low Altitude Acrobatics (Hit Residential Area)
36.	July 5, 2001	MiG-23UB	Indian AF	Non-Fatal	Mechanical Failure After Take-Off (Ground Injuries)
37.	March 12, 2001	MiG-23BN	Indian AF	Non-Fatal	In-Flight Fire
38.	January 17, 2001	MiG-27M	Indian AF	Nonfatal	Mechanical Failure – Crashed Into School
39.	November 21, 2000	MiG-27	Indian AF	Unknown	Unknown
40.	November 15, 2000	MiG-27M	Indian AF	Unknown	Unknown
41.	November 11, 2000	MiG-23	Angolan AF	Unknown	Unknown
42.	September 6, 2000	MiG-23	Ethiopian AF	Unknown	Engine Failure
43.	June 12, 2000	MiG-27M	Indian AF	Unknown	Mechanical Failure – Crashed into Residence
44.	May 23, 2000	MiG-23	Ethiopian AF	Unknown	Unknown
45.	May 10, 2000	MiG-23	Indian AF	Non-Fatal	Engine Fire
46.	April 25, 2000	MiG-23BN	Indian AF	Fatal (1)	In-Flight Fire
47.	March 24, 2000	MiG-23UM	Indian AF	Nonfatal	Engine Failure
48.	March 14, 2000	MiG-23UB	Indian AF	Nonfatal	Mechanical Failure
49.	February 2, 2000	MiG-23BM	Indian AF	Nonfatal	Engine Failure
50.	February 1, 2000	MiG-27	Uzbekistan AF	Nonfatal	Mid-Air
51.	January 10, 2000	MiG-27M	Indian AF	Fatal (1)	Unknown
52.	January 1, 2000	MiG-23	Angolan AF	Unknown	Unknown
53.	August 1999	MiG-23	Bulgarian AF	Non-Fatal	Bird Strike (Pilot Landed Aircraft)
54.	July 2, 1999	MiG-27M	Indian AF	Fatal (1)	Unknown
55.	May 27, 1999	MiG-27M	Indian AF	Nonfatal	Engine Failure
56.	May 12, 1999	MiG-23MF	Romanian AF	Fatal (1)	LOC in Weather
57.	May 10, 2000	MiG-23	Indian AF	Nonfatal	Engine Fire
58.	March 26, 1999	MiG-23BN	Indian AF	Unknown	Unknown (Aircraft Destroyed)
59.	March 18, 1999	MiG-23	Ethiopian AF	Unknown	Unknown
60.	March 15, 1999	MiG-23	Ethiopian AF	Unknown	Unknown
61.	February 2, 1999	MiG-23BN	Indian AF	Non-Fatal	Engine Failure - LOC
62.	January 5, 1999	MiG-23	Iraqi AF	Unknown	Unknown
63.	January 1, 1999	MiG-23	Angolan AF	Unknown	Unknown
64.	January 5, 1999	MiG-23	Iraqi AF	Unknown	Fuel Starvation

65.	1999	MiG-23	Ethiopian AF	Nonfatal	Mechanical Failure
66.	October 28, 1998	MiG-27M	Indian AF	Nonfatal	Unknown
67.	October 1, 1998	MiG-23BN	Indian AF	Unknown	Crashed After Take-off
68.	August 31, 1998	MiG-27M	Indian AF	Fatal (1)	Collided With Parked Aircraft
69.	August 31, 1998	MiG-27M	Indian AF	Nonfatal	Hit by Other Aircraft
70.	August 31, 1998	MiG-27M	Indian AF	Fatal (2)	Hit by Other Aircraft
71.	June 5, 1998	MiG-23BN	Ethiopian AF	Nonfatal	Malfunction After Take-Off (AND)
72.	May 19, 1998	MiG-23UB	Czech AF	Non-Fatal	LOC During ACM
73.	March 26, 1998	MiG-27M	Indian AF	Unknown	Unknown
74.	March 16, 1998	MiG-27M	Indian AF	Unknown	Unknown
75.	November 10, 1997	MiG-27	Indian AF	Nonfatal	Mechanical Failure
76.	October 9, 1997	MiG-23BN	Indian AF	Unknown	Unknown
77.	September 14, 1997	MiG-23MF	Polish AF	Unknown	Unknown
78.	May 8, 1997	MiG-23MF	Indian AF	Unknown	Mechanical Failure
79.	March 9, 1997	MiG-23MF	Indian AF	Unknown	In-Flight Fire
80.	November 19, 1996	MiG-23UB	Czech AF	Fatal (2)	LOC - Spin
81.	June 5, 1996	MiG-23	Indian AF	Non-Fatal	Technical Failure (Aircraft Destroyed)
82.	June 4, 1996	MiG-23	Iraqi AF	Unknown	Unknown
83.	February 12, 1996	MiG-23	Russian Air Force	Nonfatal	Engine Failure on Take-Off
84.	February 9, 1996	MiG-27M	Indian AF	Fatal (1)	Bird Strike
85.	December 26, 1995	MiG-23BN	Indian AF	Non-Fatal	Mid-Air Collision (1st Aircraft)
86.	December 26, 1995	MiG-23UM	Indian AF	Non-Fatal	Mid-Air Collision (2nd Aircraft)
87.	December 1, 1995	MiG-27M	Indian AF	Unknown	Unknown
88.	November 10, 1995	MiG-23	Indian AF	Unknown	Unknown (Aircraft Destroyed)
89.	September 13, 1995	MiG-23UM	Hungarian AF	Fatal (2)	Mid-Air Collision (Ejection System Damaged)
90.	October 5, 1994	MiG-27M	Indian AF	Unknown	Unknown
91.	September 3, 1994	MiG-23	Angolan AF	Unknown	Unknown
92.	August 19, 1994	MiG-27M	Indian AF	Nonfatal	Engine Flame-Out
93.	August 9, 1994	MiG-23MF	Romanian AF	Non-Fatal	In-Flight Fire - Fuel Line Rupture on Final
94.	August 4, 1994	MiG-23	Russian AF	Fatal (1)	Engine failure – Pilot Ejected – Fatality on the Ground
95.	August 3, 1994	MiG-23BN	Bulgarian AF	Unknown	Engine Failure
96.	March 10, 1994	MiG-23UB	Romanian AF	Nonfatal	Engine Failure
97.	March 2, 1994	MiG-23	Russian Air Force	Fatal (1)	Engine Failure (Fatality on the Ground)
98.	January 15, 1994	MiG-27M	Indian AF	Unknown	Unknown
99.	September 8, 1993	MiG-23BN	Indian AF	Fatal (1)	Unknown
100.	August 5, 1993	MiG-27M	Indian AF	Unknown	Unknown
101.	May 13, 1993	MiG-23MF	Romanian AF	Nonfatal	Autopilot Failure on Pitch Mode – LOC After Take-Off
102.	March 20, 1993	MiG-23	Indian AF	Unknown	In-Flight Canopy Separation
103.	December 22, 1992	MiG-23UB	Libyan AF	Fatal (159)	Mid-Air With Boeing 727 Airliner
104.	September 19, 1992	MiG-27K	Soviet Air Force	Unknown	Unknown
105.	September 10, 1992	MiG-23	Indian AF	Non-Fatal	Unknown
106.	May 14, 1992	MiG-27M	Indian AF	Unknown	Unknown
107.	April 3, 1992	MiG-23BN	Indian AF	Non-Fatal	Engine Failure (Flame-out Firing Cannon)
108.	February 17, 1992	MiG-23	Russian Air Force	Nonfatal	Unknown
109.	January 27, 1992	MiG-23UB	Czech AF	Unknown	Maneuvering (Possible LOC)
110.	November 19, 1991	MiG-23UM	Russian Air Force	Nonfatal	Bird Strike
111.	October 31, 1991	MiG-23MF	Czech AF	Unknown	Landing Accident
112.	October 8, 1991	MiG-23UB	Romanian AF	Nonfatal	Landing Gear Retracted (Failed) During Take-Off
113.	September 10, 1991	MiG-27M	Indian AF	Nonfatal	G LOC During ACM – Spin - Ejection
114.	August 14, 1991	MiG-27K	Soviet Air Force	Unknown	Unknown
115.	July 17, 1991	MiG-27M	Indian AF	Nonfatal	Fire Before Take-Off
116.	July 15, 1991	MiG-23	Russian AF	Fatal (1)	Unknown
117.	July 5, 1991	MiG-23P	Russian Air Force	Nonfatal	Engine Failure
118.	July 1991	MiG-23	Russian Air Force	Non-Fatal	Engine Flame-Out
119.	June 1991	MiG-23	Russian Air Force	Non-Fatal	LOC During Acrobatics
120.	May 17, 1991	MiG-23BN	Indian AF	Non-Fatal	LOC on Take-off Accident (Aircraft Destroyed)
121.	May 6, 1991	MiG 27	Russian Air Force	Nonfatal	Smoke in the Cockpit
122.	May 2, 1991	MiG-23ML	Angolan AF	Unknown	Unknown (1st Aircraft)
123.	May 2, 1991	MiG-23ML	Angolan AF	Unknown	Unknown (2nd Aircraft)
124.	January 31, 1991	MiG-27	Russian Air Force	Nonfatal	Engine Failure
125.	January 31, 1991	MiG-23M	Russian Air Force	Nonfatal	Engine Failure
126.	November 30, 1990	MiG-23MLD	Soviet Air Force	Nonfatal	Mechanical Failure
127.	November 11, 1990	MiG-27	Soviet Air Force	Nonfatal	Engine Failure
128.	October 5, 1990	MiG-23MF	Angolan AF	Unknown	Unknown
129.	September 16, 1990	MiG-23	Hungarian AF	Fatal (1)	Unknown
130.	September 13, 1990	MiG-23ML	DDR Luftstreitkräfte	Fatal (1)	LOC - Pilot Spatial Disorientation
131.	September 5, 1990	MiG-23MLD	Soviet Air Force	Nonfatal	Engine Fire
132.	July 17, 1990	MiG-23BN	Bulgarian AF	Non-Fatal	Pilot Spatial Disorientation
133.	June 29, 1990	MiG-23M	Soviet Air Force	Nonfatal	Engine Failure
134.	June 15, 1990	MiG-23MF	Angolan AF	Unknown	Unknown
135.	May 18, 1990	MiG-23M	Soviet Air Force	Nonfatal	Engine Failure

136.	May 16, 1990	MiG-23MF	Czech AF	Non-Fatal	Engine Surge
137.	April 20, 1990	MiG-23MF	Hungarian AF	Nonfatal	Unknown
138.	April 6, 1990	MiG-23MF	Bulgarian AF	Non-Fatal	Pilot Spatial Disorientation
139.	March 30, 1990	MiG-27M	Indian AF	Fatal	Crashed After Take-Off
140.	March 1, 1990	MiG-27M	Indian AF	Fatal (50)	Mechanical Failure – Killed 50 on the Ground
141.	February 26, 1990	MiG-23MLD	Soviet Air Force	Nonfatal	Fuel Problem
142.	February 16, 1990	MiG-23MF	Czech AF	Unknown	Engine Fire
143.	January 26, 1990	MiG-23UB	Hungarian AF	Fatal (2)	Unknown
144.	January 5, 1990	MiG-23MF	Angolan AF	Unknown	Unknown
145.	January 1, 1990	MiG-27	Soviet Air Force	Nonfatal	Unknown
146.	October 26, 1989	MiG-23MF	Angolan AF	Unknown	Unknown
147.	October 13, 1989	MiG-23BN	Bulgarian AF	Non-Fatal	Engine Failure
148.	July 4, 1989	MiG-23	Soviet Air Force	Fatal (1)	Loss of Engine Power (Person Killed on Ground)
149.	May 30, 1989	MiG-23UB	Angolan AF	Fatal (2)	Unknown
150.	May 17, 1989	MiG-23	Indian AF	Unknown	Unknown
151.	March 3, 1989	MiG-27D	Soviet Air Force	Unknown	Unknown
152.	January 11, 1989	MiG-23MLD	Soviet Air Force	Nonfatal	Mechanical Failure
153.	December 12, 1988	MiG-23UB	Soviet Air Force	Unknown	Unknown
154.	December 8, 1988	MiG-23	Angolan AF	Unknown	Crashed After Take-Off (Technical Failure)
155.	November 4, 1988	MiG-23ML	DDR Luftstreitkräfte	Non-Fatal	Engine Fire on Take-Off (Fuel Line)
156.	November 1, 1988	MiG-23UM	Indian AF	Non-Fatal	Unknown
157.	August 30, 1988	MiG-23MF	Polish AF	Unknown	Unknown
158.	July 14, 1988	MiG-23MF	Polish AF	Fatal (1)	LOC - Exceeded 16° Wing Speed Limit (LOC)
159.	June 5, 1988	MiG-23BN	Ethiopian AF	Non-Fatal	Mechanical Problems During Take-Off
160.	May 19, 1988	MiG-23UB	Czech AF	Unknown	Unknown
161.	April 15, 1988	MiG-23MLD	Bulgarian AF	Fatal	CFIT (Weather)
162.	April 8, 1988	MiG-27	Indian AF	Unknown	Unknown
163.	March 17, 1988	MiG-23ML	Angolan AF	Unknown	Unknown
164.	February 15, 1988	MiG-23ML	Angolan AF	Unknown	Unknown
165.	January 14, 1988	MiG-23ML	Angolan AF	Unknown	Unknown
166.	1988	MiG-23MLD	Soviet Air Force	Nonfatal	Overrun
167.	December 31, 1987	MiG-23ML	Angolan AF	Unknown	Unknown
168.	November 29, 1987	MiG-23ML	Angolan AF	Unknown	Unknown
169.	September 22, 1987	MiG-23	Indian AF	Fatal	Unknown
170.	August 28, 1987	MiG-23	USAF	Non-Fatal	LOC – Aircraft Destroyed (Red Eagles: Pilot Ejected)
171.	August 1987	MiG-23MF	DDR Luftstreitkräfte	Nonfatal	Engine Failure – Hydraulic Failure (AND)
172.	July 1, 1987	MiG-23MF	Bulgarian AF	Fatal	Engine Failure - Oil Pressure Problems
173.	July 1987	MiG-23ML	DDR Luftstreitkräfte	Non-Fatal	Engine Failure
174.	June 17, 1987	MiG-23UB	DDR Luftstreitkräfte	Non-Fatal	Drag Chute Failure – Deployed on TO (Aircraft Destroyed)
175.	June 15, 1987	MiG-27D	Soviet Air Force	Nonfatal	Engine Failure
176.	1987	MiG-23UB	Bulgarian AF	Non-Fatal	Drag Chute Failure – Deployed Early (Aircraft Destroyed)
177.	1987	MiG-23ML	Soviet Air Force	Fatal (1)	Flew Into the Ground
178.	October 16, 1986	MiG-23UB	Soviet Air Force	Nonfatal	LOC
179.	October 16, 1986	MiG-23MLD	Soviet Air Force	Nonfatal	Mechanical Failure
180.	September 16, 1986	MiG-23P	Soviet Air Force	Fatal (1)	Mid-Air (1st Aircraft)
181.	September 16, 1986	MiG-23P	Soviet Air Force	Nonfatal	Mid-Air (2nd Aircraft)
182.	September 13, 1986	MiG-23ML	Angolan AF	Unknown	Unknown
183.	September 1986	MiG-23UB	Romanian AF	Nonfatal	Engine Failure After Afterburner Turned Off After Take-Off
184.	July 25, 1986	MiG-23ML	Angolan AF	Unknown	Unknown
185.	June 11, 1986	MiG-23N	DDR Luftstreitkräfte	Non-Fatal	Flight Control Failure (Lateral Trim)
186.	May 21, 1986	MiG-23UB	DDR Luftstreitkräfte	Non-Fatal	LOC During Low Altitude Maneuvering
187.	March 24, 1986	MiG-23ML	Soviet Air Force	Unknown	Mid-Air (1st Aircraft)
188.	March 24, 1986	MiG-23ML	Soviet Air Force	Unknown	Mid-Air (2nd Aircraft)
189.	December 4, 1985	MiG-23BN	DDR Luftstreitkräfte	Fatal	LOC
190.	November 13, 1985	MiG-23MF	Polish AF	Unknown	Unknown
191.	September 16, 1985	MiG-23BN	Bulgarian AF	Fatal	Pilot Spatial Disorientation
192.	July 7, 1985	MiG-23 MLA	Bulgarian AF	Non-Fatal	Mid-Air (1st Aircraft)
193.	July 7, 1985	MiG-23 MLA	Bulgarian AF	Fatal	Mid-Air (2nd Aircraft)
194.	March 21, 1985	MiG-23MF	Hungarian AF	Nonfatal	Structural Failure (Left Stabilizer Separated)
195.	March 12, 1985	MiG-23ML	Angolan AF	Unknown	Unknown
196.	February 15, 1985	MiG-23BN	Czech AF	Nonfatal	Flight Controls Failure (Autopilot)
197.	December 18, 1984	MiG-23MF	Bulgarian AF	Unknown	Unknown
198.	August 28, 1984	MiG-23BN	Czech AF	Unknown	Mid-Air (1st Aircraft)
199.	August 28, 1984	MiG-23BN	Czech AF	Fatal (1)	Mid-Air (2nd Aircraft)
200.	August 9, 1984	MiG-23ML	Angolan AF	Nonfatal	Hard Landing – Inadvertent Ejection
201.	August 9, 1984	MiG-23ML	Angolan AF	Unknown	Unknown
202.	August 7, 1984	MiG-23BN	Bulgarian AF	Non-Fatal	Engine Failure During Take-Off
203.	July 28, 1984	MiG-23MF	Bulgarian AF	Unknown	Unknown
204.	July 6, 1984	MiG-23	Indian AF	Fatal (1)	Unknown
205.	May 21, 1984	MiG-23BN	Ethiopian AF	Unknown	Unknown
206.	May 5, 1984	MiG-23MF	Polish AF	Unknown	Unknown

207.	April 26, 1984	MiG-23BN	USAF	Fatal	LOC – Throttle Inhibitor (Aircraft Destroyed)
208.	April 14, 1984	MiG-23UB	Romanian AF	Non-Fatal	Engine Failure
209.	March 12, 1984	MiG-23ML	DDR Luftstreitkräfte	Fatal	Engine Fire
210.	January 9, 1984	MiG-23UB	Soviet Air Force	Fatal (1)	Unknown
211.	January 9, 1984	MiG-23UB	Soviet Air Force	Nonfatal	Unknown
212.	December 14, 1983	MiG-23	Soviet Air Force	Fatal	Crashed on Take-Off
213.	November 28, 1983	MiG-23MF	Indian AF	Unknown	Bird Strike
214.	October 3, 1983	MiG-23UB	DDR Luftstreitkräfte	Fatal (2)	Undershoot (Wrong Flap Setting)
215.	September 15, 1983	MiG-23MF	Bulgarian AF	Unknown	Unknown
216.	March 23, 1983	MiG-23UB	Soviet Air Force	Fatal	Unknown
217.	March 9, 1983	MiG-23ML	DDR Luftstreitkräfte	Fatal	LOC at Night
218.	February 21, 1983	MiG-23MF	DDR Luftstreitkräfte	Nonfatal	Engine Fire
219.	February 4, 1983	MiG-27K	Soviet Air Force	Fatal (1)	Crashed During Instrument Approach
220.	1983	MiG-23	Soviet Air Force	Fatal (1)	Crashed on landing
221.	October 21, 1982	MiG-23	USAF	Fatal	Engine Fire - Ruptured Afterburner Fuel Line (Red Eagles)
222.	July 29, 1982	MiG-23BN	DDR Luftstreitkräfte	Non-Fatal	LOC
223.	July 12, 1982	MiG-23ML	Soviet Air Force	Nonfatal	Mid Air
224.	December 1, 1981	MiG-23MF	Bulgarian AF	Unknown	Damaged Aircraft
225.	May 25, 1981	MiG-23MF	Polish AF	Unknown	Unknown
226.	February 20, 1981	MiG-23B	Soviet Air Force	Unknown	Unknown
227.	July 7, 1980	MiG-23MF	DDR Luftstreitkräfte	Non-Fatal	Overrun – Barrier (AND)
228.	June 27, 1980	MiG-23	Libyan AF	Fatal	Possible CFIT
229.	June 5, 1980	MiG-23BN	DDR Luftstreitkräfte	Fatal	LOC
230.	January 1980	MiG-23UB	Hungarian AF	Fatal (2)	Unknown
231.	September 21, 1978	MiG-23ML	Soviet Air Force	Non-Fatal	Engine Fire
232.	August 2, 1978	MiG-23MF	DDR Luftstreitkräfte	Nonfatal	Undershoot – Severe Damage
233.	June 8, 1979	MiG-23M	Soviet Air Force	Nonfatal	Engine Failure
234.	March 22, 1978	MiG-23B	Soviet Air Force	Unknown	Unknown
235.	December 16, 1977	MiG-23ML	Soviet Air Force	Fatal	Unknown
236.	July 25, 1977	MiG-23BM	Soviet Air Force	Unknown	Unknown
237.	July 8, 1977	MiG-23B	Soviet Air Force	Unknown	Unknown
238.	June 3, 1977	MiG-23UB	Soviet Air Force	Fatal (2)	LOC
239.	May 27, 1977	MiG-23B	Soviet Air Force	Unknown	Unknown
240.	October 30, 1976	MiG-23M	Soviet Air Force	Fatal	LOC
241.	March 29, 1976	MiG-23B	Soviet Air Force	Nonfatal	Engine Failure
242.	January 17, 1976	MiG-23UB	Soviet Air Force	Nonfatal	Flight Control Failure
243.	1975	MiG-23	Soviet Air Force	Fatal	Swing Wing System Failure (1st Aircraft)
244.	1975	MiG-23	Soviet Air Force	Fatal	Swing Wing System Failure (2nd Aircraft)
245.	November 1974	MiG-23BN	Iraqi AF	Unknown	Unknown (1st Aircraft)
246.	May 20, 1974	MiG-23UB	Soviet Air Force	Unknown	Unknown
247.	April 1974	MiG-23BN	Iraqi AF	Unknown	Unknown (2nd Aircraft)
248.	1974	MiG-23MS	Syrian AF	Unknown	Unknown (1st Aircraft)
249.	1974	MiG-23MS	Syrian AF	Unknown	Unknown (2nd Aircraft)
250.	1974	MiG-23MS	Syrian AF	Unknown	Unknown (3rd Aircraft)
251.	June 8, 1972	MiG-23UB	Soviet AF	Fatal	Engine Failure
252.	September 26, 1971	MiG-23	Soviet AF	Fatal	Aircraft Fire


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